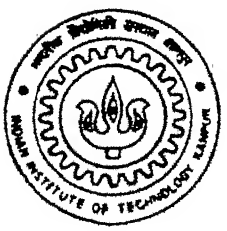
DEVELOPMENT OF METHODOLOGY FOR SOCIO-ECONOMIC IMPACT ASSESSMENT OF LARGE WATER RESOURCES PROJECTS

by

Manu Mittal



Environmental Engineering and Management Program
Department of Civil Engineering
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A Thesis Submitted in Partial
Fulfilment of the
requirements for the Degree
of Master of Technology

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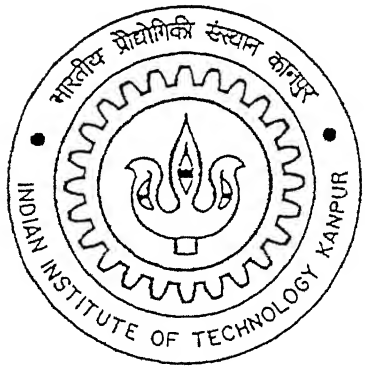

to the

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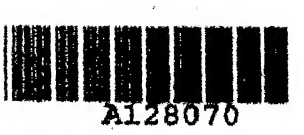

CERTIFICATE

It is to certify that the work contained in the thesis titled **Development of Methodology For Socio-Economic Impact Assessment of Large Water Resources Projects** by Manu Mittal has been carried out under our supervision.

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To

My parents

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Contents

List of Figures

List of Tables

ABSTRACT

An attempt has been made to develop a comprehensive and detailed methodology for evaluation of socio-economic impacts of large water resource projects. Review of literature available on this matter indicate that such impacts are nebulous, complex, and highly nuanced, and hence not well defined till this date. Socio-Economic Impact Assessment (SIA), which is conducted to measure these impacts, thus serves merely as a formality in wake of limited knowledge available both to the project proponent and the monitoring agency regarding such impacts. This has resulted in underestimating or misunderstanding of the nature of impacts, resulting in large-scale protest by the existing populations in the project area.

The work reported in this thesis focuses on the classification of the project affected persons according to the losses suffered and the benefits enjoyed by them. Stress has also been laid on the exhaustive identification of the socio-economic parameters or impact factors. These parameters need to be monitored to evaluate the true impact of the project on the socio-economic status of the affected population.

The validity of the impact factors identified in the course of this study were verified by undertaking a real case study of Obra Dam (UP) area. Extensive interactions with the local population in this area, most of whom are affected by water resources and thermal power projects, indicate that the impact factors identified were realistic. Thus, it can be confidently stated that any SIA study conducted using the impact factors presented in this dissertation is likely to produce results that present a reasonably accurate picture of the socio-economic realities and the subsequent impacts of project implementation on these conditions.

A comprehensive methodology has been presented for the conduction of SIA studies. This includes guidelines for conducting baseline and predictive studies based on the identified impact factors, methods and guidelines for assessment of impacts, guidelines for incorporating mitigation measures to reduce the magnitude, nature or extent of the impact, and the methodology for final decision-making regarding project implementation.

CHAPTER 1
INTRODUCTION

Energy and infrastructure are essential components for national development. No nation can progress without laying stress on development projects such as dams, power plants, transportation systems, telecommunications systems, irrigation canals, heavy industries etc. Since independence, Indian government has been trying to promote such projects for the betterment and welfare of the nation and its citizens. The prevalent idea was that through intensive industrialization and urbanization, India could overcome the handicap of its colonial past and catch up with the rest of the world. India did make rapid progress in many fields. However, even after five decades of independence, a United Nations Development Report (Baviskar, 1997) states that about 423 million people in India, i.e., about half the national population, is below the poverty line.

It is thus undeniable that the policies adopted for development have fallen far short of the expectations. The pace of economic development is slow, leading to a persistence of poverty. Additionally, other unpleasant consequences of development have been the consequent environmental degradation, and the systematic impoverishment of the natural resource base upon which rural poor depend for survival.

Some experts contend that present developmental theories, which stress on exploitation of natural resources for growth and development, fail to recognize the physical limits, imposed by ecological systems on economic activity, and hence are unsustainable. The concept of sustainable development, which has emerged in recent years, stresses on economic growth within the limits of ecosystems' carrying capacity. As defined by United Nations World Commission on Environment and Development (Khanna, 1991) "*Sustainable development must meet the needs of the present generation without compromising the ability of future generations to meet their own needs and aspirations.*" Thus contrary to the conventional developmental theories, sustainable development stresses on four essential factors; carrying capacity based development process, structural changes in the economic sector, preventive environmental policy, and environmental impact assessment (EIA).

It is this fourth point, i.e., role of EIA in developmental planning, that has received the most attention. Conceptually, EIA is an ideal anticipatory mechanism, which establishes quantitative values for parameters indicating the quality of the environment before, during and after the proposed developmental activity, thus allowing measures that ensure environmental compatibility. It presents a clear and concise picture of benefits and costs associated with alternative courses of action and provides a mechanism for merging the concerns of the environment and economics in the decision making. Defining the word "Environment" to include not only the physical environment, but also the social, economic, cultural and aesthetic environments can broaden the scope of EIA. In effect, this definition brings all the human-interest issues under the purview of EIA.

Socio-economic impact assessment (SIA), which is a part of the EIA process, is a mechanism for determining the impact of a developmental activity or project on the social and economic activities of the affected population. However, such a mechanism is easier to conceptualize, than to implement. There are serious problems in proper identification, and assessment of the issues relating to the socio-economic aspects of developmental projects. This is because the issues are nebulous, complex, difficult to define, and not amenable to quantification. This is one of the reasons for the cursory treatment of socio-economic impact factors. Consideration of these issues is often treated merely as a formality to satisfy the monitoring agency requirements. It is this lack of empathy towards the socio-economic issues on the part of the government, the project proponents, and the various monitoring agencies that has been instrumental in generating social unrest against large developmental projects.

It is thus necessary to develop a methodology for conducting SIA studies, specially for large water resources projects, which seem to the most controversial. International funding agencies, viz. World Bank, Asian Development Bank, etc. have already formulated guidelines of the socio-economic impact studies. These guidelines have to be followed by the donor countries for continued availability of funds for projects. However, most of these guidelines pertain to the rehabilitation and resettlement. Socio-economic impacts of a

project are far wider and complex than the effects on the people who are involuntarily displaced, and thus adversely affected. They encompass the people in the project area, who are not displaced, but profoundly affected (both beneficially and adversely) by the project. They also include the regional population, who will derive many of the direct benefits, benefits from indirect economic development, and long-term adverse consequences of the project implementation.

This dissertation attempts to develop the methodology for a comprehensive SIA study for large water resources projects. This includes guidelines for conducting baseline and predictive studies based on the identified impact factors, methods and guidelines for assessment of impacts, guidelines for incorporating mitigation measures to reduce the magnitude, nature or extent of the impact, and the methodology for final decision-making regarding project implementation.

CHAPTER 2

BACKGROUND: IMPACT OF DEVELOPMENT ON PEOPLE'S LIVES

2.1 Introduction

An analysis of progress made in India since Independence, shows success stories such as Green Revolution, Operation Flood, and the Nuclear / Space Programme. Additionally, rapid progress in areas related to defence, science and technology, textiles, chemicals and petrochemical industries, infrastructure and power-related projects, mining, engineering and related fields are also apparent. Some progress in the sectors of health, education, and poverty alleviation is also noticed.

Here are some examples, that will illustrate the progress achieved in various fields; Indian dependency on food imports have shrunk to such an extent that today it imports less than 2% of the food that it consumes (UNDP, 1993). Over the last decade, Indian Gross National Product (GNP) has been growing annually at a respectable rate of 5.4%. The improvement in the quality of life is reflected in health statistics; an average Indian who in 1960 would have died at an age of 44 can today expect to live for about 60 years. (UNDP, 1993). On the political front, India has grown from the status of a colony to a fully independent nation having a voice in the world affairs. Keeping to our past traditions our leaders followed a policy of peace and harmony. Principles of *Panchsheel*, not belonging to any power block, being the founding member of the Non Aligned Moment (NAM), sending armed forces to all the UN peace keeping missions, etc. are a testimony to this.

However, the one basic question that arises is, has the progress percolated down to the grass-root level, thus improving the social, economic and financial conditions of the common people i.e., the standard of living of the 70% of the population that lives mostly in rural or in tribal areas. Statistics show that, the number of government hospitals, schools, training centres, security personnel, job opportunities etc., have all increased substantially. Yet, there is a general dissatisfaction, not only with the pace of development, but also with the nature and consequences of development.

2.2 Gandhian versus Nehruvian Models of Indian Economic Development

At the time of the independence, Indian State was confronted by two different plans of reconstruction.

- The Gandhian vision of revitalising the village economy as the basis of development.
- Nehruvian plan for prosperity through rapid industrialisation.

On 5th Oct 1945, Gandhi wrote a letter to Nehru in which he outlined his dream of free India:

I believe that if India is to attain full freedom and through India the world as well then sooner or later we will have to live in the villages—in huts not in palaces. A few billion people can never live happily and peaceably in cities and palaces.... My village exists today in my imagination... The villagers in this imagined village will not be apathetic... They will not lead their life like animals in squalid dark rooms. Men and women will live freely and be prepared to face the whole world. The village will not know cholera, plague or smallpox. No one will live indolently, or luxuriously. After all this, I can think of many things, which will have to be produced on large scale. May be there will be railways, so also post and telegraph. What it will have and what it will not, I do not know. Nor do I care. If I can maintain the essence, the rest will mean free facility to come and settle. And if I leave the essence I leave everything. (Chandra, 1987)

'*God forbid that India should take to industrialism in the manner of the west*', Gandhi observed. '*The economic imperialism of a single tiny island kingdom is today keeping the worlds in chains. If an entire nation of 300 million took to similar economic exploitation, it would strip the world bare as locusts*'. The appeal of the Mahatma lay in his program of revitalising the village communities through craft production by employing simple technologies to provide jobs and a decent livelihood to the predominately rural population.

Despite the importance that Gandhi had in the national politics, his vision was eclipsed within the Congress party by the ideas of Nehru, Sardar Patel and others. His vision made

no impact on the mind of Nehru who replied rather brusquely to Gandhi's letter of 1945. *"It is many years since I read Hind Swaraj, and I have only a vague picture in my mind. But even when I read it twenty or more years ago it seemed to be completely unreal...A village normally speaking, is backward intellectually and culturally and no progress can be made from a backward environment".*

Most Indian nationalists believed that India's reconstruction could only come through the infusion of modern science, and materially through the adoption of large-scale industrialisation. Through massive industrialisation and urbanisation, fostered by a strong nation state, India could overcome the handicaps of it's colonial past to catch up with the West. To them, the rapid strides taken by Germany under Bismarck, by Meiji Japan and Stalinist Russia proved that this economic miracle was possible. At that time the most important decision of the Congress leadership was adoption of the "*industrialise or perish*" model of economic development. This strategy indiscriminately applied modern technologies with little regard for social or ecological consequences.

2.3 The Persistence of Poverty

It was assumed that the benefits of industrial growth, increased production, employment, and income, would trickle down through the economy to those at the very bottom. However, the status of most of the rural landless and urban poor has remained unchanged or even worsened since independence. For the 423 million people below the poverty line, i.e., almost half the nation, development has been a distant phenomenon watched from the periphery (UNDP, 1993). Even after five decades of independence most of the Indians are trapped in a web of poverty and powerlessness. This profile of deprivation has a numbing quality because of the sheer vastness of the problem. Every year, 3.84 million children die before they reach 5 years of age, due to hunger and disease. Another 73.1 million children under five are malnourished, 72.9 million children are not enrolled in school, 281 million adults, 61% of them women are illiterate, and "*Our boast of being self sufficient in food is a cruel hoax for hundreds of millions who go hungry*" (Baviskar, 1997).

It is frequently argued that the benefits of economic growth have been neutralized by the high rate of growth of the Indian population. According to this view, poverty exists because of pressure of ever increasing numbers on a finite resource base. While population growth rate is a source of concern, it does not constitute a problem by itself. Present food production statistics, and projection for the future shows that India is more than capable of feeding its citizens adequately. Yet the fact is that this food do not reach the hungry, points to the problem of social inequality and marginalization, which has become endemic to the present policies of economic development.

2.4 Poverty and Ecological Crisis

Apart from poverty, the biggest menace that has emerged during the last two decades, particularly in the developing countries, is the wide environmental degradation and ecological destruction. The Stockholm Conference on Human Environment was convened in 1972 to discuss some of these issues.

While the industrialised nations showed their enthusiasm for this conference, most of the developing countries remained sceptical about it's value, believing that the problem was largely an affliction of the industrially developed society. Since the developing countries were not sufficiently industrialised and urbanised, their problems in this regard were less urgent. The warning of the impending ecological crisis was dismissed as a conspiracy of the industrialised nations to control the process of industrialisation in developing countries, thus decelerating their efforts to remove poverty.

Indira Gandhi stated, "*the environmental problems of developing countries are not the side effects of excessive industrialisation, but reflects the inadequacy of the development as the cause of environmental destruction, but (industrialisation) to us it is a primary means of improving the environment for living or providing food, water, sanitation and shelter, of making the deserts green and the mountains habitable.*"

However, it is now realised that the statements above are only partially correct, i.e., poverty is not the only reason for the ecological crisis and social deprivation in India, the

present developmental policies are also greatly responsible. It is now generally accepted that 'development', without adequate attention being paid to consequent ecological and social concerns may actually worsen the quality of life and living standards of the vulnerable sections of our society.

2.5 Dimensions of Environmental Degradation

Current developmental policies have fundamentally altered two crucial bases of production; land and water. In 1990, India had a land area of 328.7 million hectares, 55.6% of that was considered arable. 45.68 million hectares or 25% of the arable land is irrigated and only 22.4% of the total land is designated as forest (Agarwal, 1985). According to B.B.Vohra, (Baviskar, 1997) who was the chairperson of the advisory board on energy, only 42% of the area designated as forest is actually under adequate trees or grass cover the rest is more or less completely devoid of vegetation. With satellite imaging more accurate estimation of deforestation is possible. According to the national remote sensing agency, forest covered 55.5 million hectares or about 16.89% of the total land area in 1972, which has dropped to 32.8 million hectares or about 10% of the total land area in the present decade. On the basis of information supplied by the Ministry of Agriculture, Vohra estimated that 75% of our agricultural land is degraded due to soil erosion, water logging and salinisation. Productivity of land is diminishing and its use in future is uncertain. It takes nearly 900 years to form one inch of top soil, but it may take only one monsoon or one badly designed canal system to lay it waste for ever.

Deforestation, together with the emphasis on building embankments and dams, has led to steady increase in the incidence of floods in the fertile plains of north India. Annual flood damage has increased nearly forty times from an average of Rs 60 crores per year in the 1950's to an incredible Rs 2307 crores a year in the 1980's. The area affected by floods have shot up from an average of 6.4 million hectares a year to 9.0 million hectares a year (Agarwal, 1991). The embankments and dams which were made to control the damage caused by floods have actually prevented the nutrient rich silt carried by rivers from being deposited in the soil, there by depriving the flood plains of valuable source of

nutrient. The sediment now accumulates in the river bed, raising its so that the river overflows its sides and devastates more land and property.

Ironically most of the environmental losses be it physical, social, economical, cultural or esthetical, do not figure in national income accounts. As shown in the table below, many things, which are really costs to the economy, are counted as benefits by conventional GDP calculations. When a GDP or industrial growth rate is calculated, costs due to loss of topsoil and land degradation are not included in the economic decision making. Even though environmental depreciation fundamentally affects the stream of value derived from nature in future, even though the immediate effects of ecological destruction are real and crippling, these costs tend to remain invisible. In fact paradoxically, the environmental destruction appears on the credit side of the national ledger if it provides a one time increase in production even if that increase destroy all possible future benefits.

Table 2.1 A Partial List of Possible Corrections to GDP Calculations to Account for Sustainability (Harandeen , 1990)

Item	Correction to Conventional GDP
Conventional GDP counts these as benefits, but are actually cost	
Medical care of accident victims	Negative
Medical care for pollution caused conditions	Negative
Crime prevention costs	Negative
Commuting costs	Negative
National advertising	Negative
Conventional GDP does not include these, but should include these as benefits	
Household labour	Positive
Conventional GDP does not include these, but should count them as costs	
Resource Depletion	Negative
Long-term environmental damage	Negative
Deviation from flat income distribution	Negative

2.6 Ecological Crisis and Conventional Models of Development

It is pertinent to critically examine the consequences of adopting the industrialisation and urbanisation model after 50 years of independence. It is undeniable that the policies adopted for development have fallen far short of the expectations. The pace of development is not only slow, but the consequences of such development are often unacceptable. One of the most unpleasant consequences has been the systematic impoverishment of the natural resource base upon which rural poor depend for survival. It is ironical that the bulk of development policies justified in the national interest have actually diminished poor peoples' ability to control and gainfully use natural resources. Every national project is projected as beneficial for the masses even though it requires some people to surrender their land or livelihood. While the greater good of the nation appears to be a laudable cause it appears suspicious to the rural poor who are consistently chosen time and again to make all the sacrifices, while those more powerful reap the benefit. As Sharma (1992) states, '*When JawaharLal Nehru assured those displaced by Rihand dam in Singrauli in 1961, people felt that ' their suffering would not be in vain. Their instinctive sense of nobility was stirred when Nehru spoke of the nation and development. They believed in his promise of a future of plenty to be shared by all. And they half accepted the trauma of displacement believing in the promise of irrigated fields and plentiful harvest. So often have the survivors of Rihand told us that they accepted their sufferings as sacrifice for the sake of the nation. But now, after 30 years of being adrift, their lively hood even more precarious they ask, " Are we the only one chosen to make sacrifices for the nation"?*'.

The developmental model established since independence has fundamentally altered the way in which the different social groups use and have access to natural resources. The changes brought about by the independent state have created conflicts over competing claims to the environment. These conflicts range from incessant battle between the forest department and local communities to the war ranging between the Sardar Sarover Project Authorities and the Non Governmental Organisations. These claims are not merely for a greater share of goods, but involve different ways of valuing and using nature.

These issues can be further understood by examining the pattern of state intervention in the allocation of resources. It is not that the state discriminates in resource distribution. However, due to the inadequate planning and implementation of the policies regarding social and environmental issues, majority of the benefits such as those of increased employment, power, water for drinking, irrigation, industrial purpose etc., gets cornered by a particular section of the society. The government has encouraged the profligate use of natural resources, for instance, in irrigated agriculture where farmers shifted to remunerative water intensive crops such as sugarcane uncaring of the ecological and social consequences. Canal irrigation is a highly subsidised system for providing water, while the cost are borne by the state, the benefits may go to the land owners further increasing the social inequalities.

2.7 Unsustainable *versus* Sustainable Development

Development of any country is conventionally assessed in economic terms using parameters such as Gross National Product (GNP), Human Development Indices, employment opportunities etc. These criteria aim at more food, more jobs and more consumer items for the citizens, which in turn lead to improvement in the living standards. Conventional economic theories indicate that development, as defined above, requires industrialization on a large scale. Previous experiences of high growth rate and rapid industrialisation in many developed and developing countries have indeed shown an improvement in the quality of life. However, certain unpalatable side effects of such development, like urban slums with poor sanitation, drugs and crime, transport bottlenecks and chaos, accumulation of filth, noise and other forms of pollution, social unrest etc., have also been consistently recorded. Some experts contend that present economic theories, which stress on exploitation of natural resources for growth and development, fail to recognize the physical limits, imposed by ecological systems on economic activity, and hence are unsustainable. They contend that economies must expand within an ecosystem, which has limited regenerative capacities. Thus, contrary to the conventional theory of continuous material growth through exploitation of natural resources, economic activities directly undermine the potential for future development

through over exploitation of natural resources and indirectly compromise future production through discharge of residuals.

The concept of sustainable development, which has emerged in recent years, stresses on economic growth within the limits of ecosystems' carrying capacity. As defined by United Nations World Commission on Environment and Development, "*Sustainable development must meet the needs of the present generation without compromising the ability of future generations to meet their own needs and aspirations.*" It is a process in which the exploitation of resources, the direction of investments and institutional changes are all made consistent with future as well as present needs.

2.8 Essential Components of Sustainable Development

The concept of sustainable development is based on two underlying premises; first, the symbiotic relationship between the human race, which utilizes natural resources, and the natural ecosystems, which supply natural resources for human consumption and act as receptacle of wastes generated during the course of human consumption of natural resources; and second, the compatibility between ecology and economic developmental activity. Certain changes must be incorporated in conventional development planning processes to make them 'sustainable' according to the definition given above. The changes can be grouped broadly into four categories (Khanna, 1991), which will be discussed in some detail:

2.8.1 *Carrying Capacity based Development Process*

The concept of sustainable development is closely linked to the carrying capacity of the ecosystem, which may be defined as the maximum rate of resource consumption and waste discharge that can be sustained indefinitely in a defined planning region without progressively impairing bio-productivity and ecological integrity. The concept of carrying capacity implies that improvement in the quality of life is possible only when pattern and level of production/consumption activities are compatible with the capacities of the natural environment as well as social expectations. It thus involves the integration of social expectation and ecological capabilities by minimizing future differentials

between realized and desired demands of citizenry for goods and services and resource availability on one hand, and resource exploitation and assimilative capacity of the ecosystem on the other.

The differential between realized and desired resource exploitation rates and ecological carrying capacity are overcome through a combination of institutional, informational and attitudinal changes. These changes aim at controlling and modifying the external driving forces, system structure and tolerance that determine the level of desired resource exploitation and ecological carrying capacity. The success of this approach depends entirely on planners' participation in the process and its acceptance by administrative and political jurisdictions.

2.8.2 *Structural Changes in the Economic Sector*

Structural changes in the economic sector relate to increased ecological harmony and economic efficiency by adoption of 'Green" or cleaner technologies of production, utilization of renewable rather than non renewable resource base and coordination of environmental policies in economic sectors like agriculture, energy, industry, mining, transport and construction.

The aim of the structural changes is to achieve technological innovations within existing economic frameworks to achieve environmental harmony. It may involve an improvement in the material and energy utilization efficiency in production and consumption in order to minimize the expense on the environmental protection while keeping the cost of natural resource exploitation within acceptable limits. It may also entail the substitution of non- renewable resource base by a renewable one to achieve sustainable development. Technological substitutions on large scale leading to introduction of technologies better suited to natural environment, i.e., "Green" engineering may also be cited as an example in this regard.

2.8.3 *Preventive Environmental Policy*

In order to maintain and effectively restore the quality of environment, environmental policies must be directed towards anticipative and preventive strategies, which focus on actions necessary to prevent potential environmental damage. This concept should be implemented by the prevention of all harmful emissions that exceed the assimilative capacity of the ecosystem through greater and improved recycling, introduction of low/non emission technologies, greater use of renewable resources, use of efficient combustion process and active environmental management. Successful application of preventive environmental policy requires changes in economic, social, administrative and political systems. It warrants modernization of all environment relevant policy areas like agriculture, technology and energy. If environmental damage is to be prevented it must be ensured that ecological consideration have been integrated into these inter-dependent policy areas.

There are many impediments existing today in the implementation of preventive environmental policy. The present style of information gathering is based on reactive and curative environmental reports focussing on specific environmental media. Likewise, appropriate analytical methods for forecasting realistic future environmental damages, institutional arrangements, administrative skills and political procedures are also absent. Preventive strategies however, cannot avoid future environmental damage totally, but at the best limit it more effectively than reactive policy. Adoption of preventive strategies therefore doesn't make reactive strategies superfluous, as backlogs in environmental damage must be cleared and unforeseen problems dealt with. Pragmatically speaking, the preventive and reactive approaches complement each other and that is how the legislative, administrative, institutional and policy formulations must be devised.

2.8.4 Role of Environmental Impact Assessment

EIA is potentially one of the most valuable, inter disciplinary, object oriented, decision making tools with respect to alternate routes for development, process technologies and project sites. It is an ideal anticipatory mechanism, which establishes quantitative values for parameters indicating the quality of the environment before, during and after the

proposed developmental activity, thus allowing measures that ensures environmental compatibility. It presents a clear and concise picture of all benefit and cost associated with alternative courses of action and provides a mechanism for merging the concerns of the environment and economics in the decision making. EIA could form a major instrument for the assessment of developmental activity in the context of regional carrying capacity.

2.9 Environmental Impact Assessment as a Development Tool

The environmental implications of the developmental process should to be considered at the national level, regional level, and for individual projects. EIA should ideally be undertaken at the policy and planning level as the environmental consequences of projects often arise due to higher level decisions. Policy EIA, however, is an extremely complex issue, largely due to the fact that the potential range of alternatives to achieve a desired goal can be almost unlimited. This problem may be resolved to some extent through a hierarchical approach in which the number of alternatives are reduced by defining the problem in terms of a series of choices.

The most appropriate stage for implementing EIA is at the level of district or regional planning, since at this stage a number of alternatives are available to developer. A conceptual limitation of EIA, that becomes apparent, is that it does not incorporate the strategies of preventive environmental interventions. The issues of resource conservation, waste minimization, by product recovery, improvement in efficiency of equipment etc., need to be pursued as explicit goals in EIA.

EIA, as presently conceived, acts merely as a project tool and does not address to developmental programmes at the policy and planning level. For example, policy initiatives in such areas as international trade, tax incentives, energy conservation, agricultural subsidies, predator control etc. have never been the subject of environmental review. Project level decisions are many times constrained by existing policies and plans and the range of possible alternatives in project EIA is therefore often small or even non-existent. Experiences over years have shown that EIAs are always conducted under

severe limitations of time, manpower, financial resources and data. India has unique problems in this respect due to its vastness, variety of climates, cultures and customs resulting in widely diversified life styles, varying nature of terrain, flora and fauna, etc. No reliable comprehensive environmental information base exists and need for extensive data collection makes EIA an extremely cumbersome and time consuming exercise.

The public acceptance of impact assessment is another issue of procedural concern. Public hearing for resolving environmental issues is not yet practiced in India. Public participation needs to be incorporated in the review process not only to enable consideration of local knowledge and preference in project planning but also for avoiding conflicts.

The above discussion clearly shows that EIA can be used as a tool for sustainable development. Most ecological problems are the cumulative results of environmental and social impacts of human activity in the region. Planning for sustainable development in the context of ecosystem carrying capacity thus requires systematic identification, quantification and management of cumulative trends in significant environmental variables on a regional basis. Whether these trends are driven only by local-regional activity or are result of larger global factors, the necessary corrective actions must be implemented in or jurisdictions on site specific basis. Functional planning region need to be identified based on ecological criteria such as climatic and vegetation pattern, soil classification and water shed boundaries rather than political jurisdictions. Within the context of sustainable development, regional EIA could provide the means for estimation of the developmental limits imposed by regional carrying capacity.

2.10 Socio-Economic Impact Assessment (SIA)

There is a serious problem in proper identification, and assessment of the issues relating to the socio-economic aspects of big developmental projects, particularly the multipurpose river valley projects. This is one of the reasons for the cursory treatment of socio-economic impact factors. These factors are often treated merely as a formality to satisfy the monitoring agency requirements. It is this lack of empathy towards the socio-

economic issues on the part of the government, the project proponents, and the various monitoring agencies that has been instrumental in generating growing social unrest against large developmental projects, for example, the Narmada Bachao Andolan, the popular protest at Baliapal, etc.

SIA is a phrase, which is used interchangeably with socio-economic impact considerations. Impacts on health, recreational activities, aesthetic interest, land and housing values, job opportunities, community cohesion, life style, governmental activities, psychological well being and behavioural response on the part of the individuals, groups and communities, etc., are included in such assessment. The process also involves a systematic and advanced appraisal of the impact of the development projects or policy changes on the day to day quality of life of persons and communities. Specific advantages and features of the SIA process include the following;

- SIA is a systematic effort to identify, analyse and evaluate socio-economic impacts of a proposed project or policy change, on individuals and social groups within a community, or an entire community. This effort is undertaken before the project implementation, so that the information derived from the SIA can actually influence decision on project implementation.
- SIA is a means for developing alternatives to the proposed course of action and determining the full range of consequences for each alternative.
- SIA increases knowledge of the project proponent and affected communities about each other.
- SIA raises consciousness and level of understanding of the affected community and puts the residents in a better position to understand the broader implication of the proposed action.
- SIA includes within it, a process to mitigate or alleviate the undesirable socio-economic impacts likely to occur.

Assessment of the significance of the predicted changes in the socio-economic environment requires an exercise of professional judgement. Every attempt should be made to use systematic and scientific rationale for a significant assessment. The conceptual framework for a systematic procedure is illustrated in the Figure 2.1. Finally,

the professional and public inputs can be used to establish value judgements. Before conducting a comprehensive SIA, it is desirable to identify various categories of people who may be directly or indirectly affected, either in a beneficial, or an adverse manner, by the particular developmental activity. Present SIA studies often fail to identify and include all categories of people affected by the developmental project, focussing attention only on the rehabilitation and resettlement of people who are directly displaced. Additionally, the identification of the impact factors for various groups of people are often done in a cursory manner, resulting in non-consideration of all but the most obvious factors.

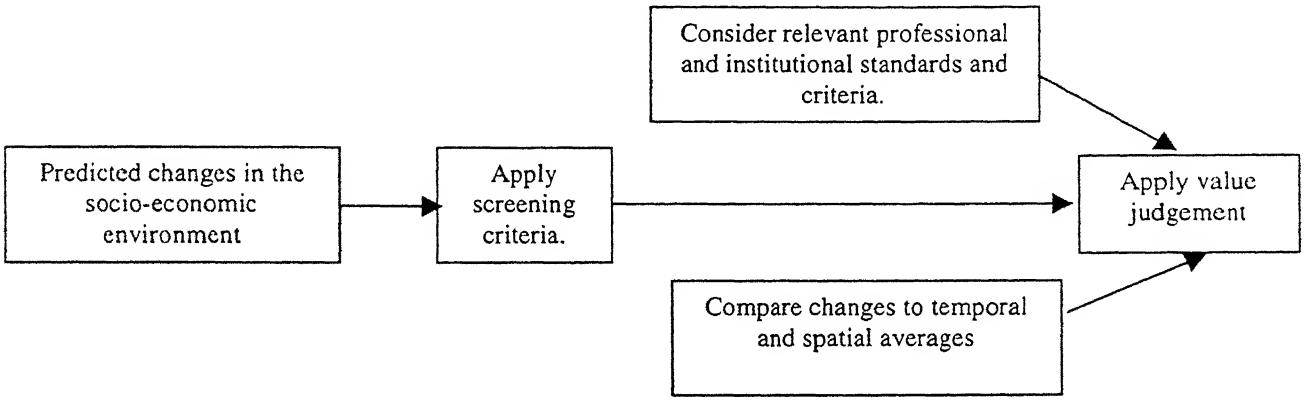


Figure 2.1 Conceptual Framework for Assessing Predicted Changes in Socio-Economic Environment (Canter, 1996)

2.11 Socio-Economic Impacts of Large Water Resources Projects

Mounting opposition to the implementation of large water resources projects, e.g., Narmada Valley project, have been witnessed of late in India. This opposition is from many angles, i.e., environmental, soil degradation, seismic and socio-economic concerns. These concerns must however, be balanced against the benefits that accrue from such projects, i.e., irrigation, hydroelectric power, direct and indirect economic development, etc. Readers are directed to Appendix A for a detailed discussion of the debate on this subject. It is apparent from such a discourse that an objective and scientific methodology is required to accurately judge the impacts of such projects before decision can be taken regarding their acceptability or otherwise. In this dissertation, an attempt has been made to develop such a methodology.

CHAPTER 3
SCOPE AND OBJECTIVE

In developing countries, the scale of development related population displacement and dislocation has grown rapidly over the past few decades. This is due to a compelling need for construction of infrastructural facilities. The world bank estimates that the displacement toll of 300 large dams that on an average comes into construction every year is estimated to be above 4 million people. In addition, millions of people, though not physically displaced, are adversely affected by such projects.

Though there are a wide range of benefits from planned developmental projects, and some of these benefits do percolate down to the affected people, yet such projects are commonly associated with the tearing of the social and economic fabric of the affected people as a result of large-scale displacement and dislocation. Most governments in developing countries do not have adequate political will and resources to mitigate the adverse effects on affected people. Often, the socio-economic impacts on the affected people are poorly understood, misunderstood, or ignored.

In recent times, international funding agencies like World Bank and Asian Development Bank have made social impact assessment compulsory for continued funding of ongoing projects, and for approval of new projects. However, these mainly deal with the resettlement and rehabilitation policies for the displaced people. In India, some organizations such as NTPC and Coal India Limited have made their own policies regarding resettlement and rehabilitation. But these policies cannot be adopted on a national scale as they are highly project specific and are made keeping an eye on the interest of project proponent whose sole interest is to get the project passed.

There is an urgent requirement for the preparation of a comprehensive methodology for socio-economic impact assessment for various infrastructural development projects in developing countries. Such methodologies must include, the identification of relevant impact factors, guidelines for conducting baseline and predictive studies based on the

identified impact factors, methods and guidelines for assessment of impacts, guidelines for incorporating mitigation measures to reduce the magnitude, nature or extent of the impact, and the methodology for final decision-making regarding project implementation.

The principal objective of this study is to develop a comprehensive methodology for conducting socio-economic impact assessment (SIA) for large water resources projects. Specifically, various objectives can be consigned under the following heads:

1. To identify various categories of persons affected by large scale water resources project through literature review

2. To identify various impact factors or parameters, which are relevant for each category of affected population. This will also be done through information obtained from secondary sources.

3. To verify the validity of the categorisation of the affected population, the relevance of the identified impact factors by gathering primary information on the above topics. A suitable field study was conducted for this purpose.

4. To develop a methodology for social impact assessment (SIA) of large water resources projects in India, based on the information gathered. This would include preparation of guidelines for conducting baseline and predictive studies. It would also include the development of guidelines for impact evaluation, i.e., impact assessment and assignment of significance numbers to various impact factors. Additionally, guidelines will be prepared for assignment of weightages to various impact factors. This will be followed by elucidation of the procedure for synthesis of the results to obtain a single score or index, signifying the acceptability or otherwise of the project from a socio-economic perspective.

CHAPTER 4

DESCRIPTION: SOCIO-ECONOMIC IMPACTS OF LARGE WATER RESOURCES PROJECTS

4.1 Description of the Problem

Socio-economic impacts are the most uncertain and difficult ones to identify, predict and assess. Externalities such as wars, currency devaluation, changes in international trade relations are nearly impossible to predict. But even with the national/regional conditions which remain relatively stable, the construction of a project may some times require unexpected adjustments by the local population. This may happen because there is always an uncertainty in predicting the ways in which the communities affected will respond. Furthermore, the strong feedback loop between socio-economic and biophysical impact can often mitigate or intensify socio-economic impacts. This uncertainty increases as the prediction is made further and further into the future. In some cases the prediction of long term consequences may be so uncertain that the decision maker has no option but to make a decision on the expected short term impact.

Keeping these limitations in mind, it is still necessary to do a detailed study of various socio-economic impacts that may arise due to project implementation. It is expected that some groups of people will be adversely affected by the project, some groups will benefit, and there will be some groups of people who will have mixed benefits. The ultimate aim of the SIA study is to quantify the predominantly qualitative knowledge about the predicted beneficial and adverse impacts of a project on various categories of people. Based on this quantification, a decision can then be made regarding the feasibility of the project from a socio-economic perspective.

As mentioned in the previous paragraph, one of the major tasks in a socio-economic impact assessment (SIA) study is the identification and categorisation of the affected population into more homogeneous groups. This categorosation is based on the likely impacts of the project on various groups of people. In case of a large water resources

project, it is logical to assume that the affected people can be divided into three major categories:

- **Category I**: People who are displaced, and are hence likely to be adversely affected by the project implementation.
- **Category II**: People in the project area, who are not displaced, but are likely to be profoundly affected by the project implementation. The impact of the project on such people is likely to be mixed, with certain sub-sections of this population enjoying benefits of the project, and others bearing the associated costs.
- **Category III**: This category consists of people who do not reside in the immediate project area, but are direct recipients of the benefits from the project. These may include the urban population receiving electricity from the project, the rural population in the command area receiving enhanced supply of irrigation water, People benefiting from the general regional economic development due to project implementation, etc. It also includes the recent migrants to the project area, i.e., construction workers, construction engineers, other professionals required for project implementation, operation, maintenance and administrative staff required during the project operation phase, and people working in the secondary and tertiary sectors in the project area.

4.2 Adverse Impacts of Large Water Resources Projects

People in categories I and II as defined above, are generally adversely affected by large water resources projects. Adverse impacts, including economic, and social dislocation, impoverishment and marginalisation, on the category I population are long-term and severe, unless adequate measures are taken to mitigate the adverse impacts. Adverse impacts on category II people are less severe, though loss of livelihood and impoverishment are potential risk factors for this category also. Additionally, both groups complain about certain inevitable consequences of development, e.g., faster paced lifestyle, increased pollution, crime, traffic, influx of migrants, despoiling of the existing scenic beauty, loss of peace and quiet, and general degradation in the quality of life. Adverse impacts on the category III population is largely not existent, except for some

long-term problems associated with irrigation like water-logging and salinity, and other minor adverse impacts related to quality of life issues. In the paragraphs to follow, some of the adverse impacts of large water resources projects will be discussed in detail.

4.2.1 Category I: People Displaced by Big Water Resources Projects

Those people who are directly displaced bear the brunt of the developmental activity. They have to virtually give up their livelihood and start their life anew at an unfamiliar place. They also have to bear the psychological trauma related to involuntary displacement, loss of livelihood, loss of common property resources, and also have to adjust to new environmental factors such as, changes in climate, language, food habits, caste hierarchy, religious customs etc. Consequently, these people are at a high risk for impoverishment.

Impoverishment Risk Model advocated by Prof. Cernea (Asthana, 1996) lists eight sub processes or risk factors that contribute to the impoverishment of such people. These are; landlessness, marginalisation, joblessness, homelessness, food insecurity, increased morbidity, social disarticulation, and loss of access to common property. Each of these risk factors will now be discussed in detail.

4.2.1.1 Landlessness. Expropriation of land removes the main foundation upon which the peoples' productive systems, commercial activities and livelihoods are constructed. This is the principal form of de-capitalization and pauperization of displaced people through loss of physical and man made capital (Cernea, 1996). Unless the same foundation is constructed elsewhere, or replaced by steady income generating employment, 'landlessness' sets in. Under such circumstances, social and economic productivity cannot be established and the affected families are impoverished.

This point will be further illustrated through an example based on the studies done in the states of Maharashtra and Gujarat in relation to the displacement of people for the Narmada Valley Project. A simple calculation based on Maharashtra and Gujarat base line studies in the Narmada Valley Area shows that each family on an average owns or

has access to 2 to 5 hectares of land through a range of methods such as owned, shared or encroached land. For proper rehabilitation and resettlement of people displaced in Maharashtra, about 8000 hectares of land is required (Dreze et al, 1997). However, even if this land is provided, it may not be enough to prevent 'landlessness', as shown below.

The land formally cultivated by the displaced people in the Narmada Valley can be divided in four categories (a) revenue land, (b) wasteland, (c) forest land, and (d) land on the bank of the river. Of these only the revenue land is registered usually in fathers, uncles or grandfathers name, which tends to be very small as a consequence of divisions and subdivisions in the family (Dreze et al, 1997). However most of the families cultivate at least 15 acres of land most of which fall under the other three categories. Due to various factors, including, outdated land records, and the fact that land compensation is given only on registered revenue land, the actual land compensation given to the PAPs is much less than the land cultivated prior to displacement. This adds to the problem of 'landlessness'. After displacement, as families grew and younger established nuclear families they could clear additional forest land. In the new resettlement colonies, access to forest is restricted. Thus any amount of land given by the government will prove to be inadequate as the families grow in size and seek alternative means of livelihood for which there is no provision in the resettlement colonies.

4.2.1.2 Loss of Access to Common Property. For poor people particularly the landless, loss of access to non-individual common property resources leads to income and livelihood deterioration. This is usually overlooked and not properly compensated under government compensation schemes. This point will be further elaborated by citing a pertinent example.

Taking the case of Mapali village in the Narmada valley we see that the tribals have a forest–based way of life. This refers not only to their economy but also to their religion, and way of life in general. The villagers' understanding of distance, personal space and possessions is deeply influenced by the geographical conditions around them. They are highly dependent on jungle produce such as wild roots, fruits, leaves, flowers, honey

berries etc., which are freely available as emergency food supply during scarcities, and add a variety to their regular diet (Dreze et al, 1997).

These villagers are very concerned with what they see as a decrease in the amount of productive resources available to them after resettlement and rehabilitation. The resources most critical in this respect are, wood and bamboo. This is an area of great concern especially with regard to building materials for houses as well as fuel for cooking, and to a lesser extent for light and warmth. It is claimed that wood and bamboo, which were freely available in their former villages, are in short supply in the resettlement site, and have to be procured at prices which are often unaffordable. Another area of grave concern is the unavailability of fodder. It is claimed that unavailability of common grazing ground will render cattle rearing impossible which, are vital to their economy.

Hence, it is seen that change in geographical location has several implications to various aspects of their lives. The loss of access to forest implies that they no longer have access to common property resources like, the river, fish, animals, grazing ground and flora. They think, "*it is a very new concept that we have to survive only on 5 acres of land that is ours. Our rights are limited only within the boundaries of the land we own. Everything else has to be bought for cash. There are no trees to pick fruits from, no river nearby, no high mountains that we cultivate and treat as ours. It is a very alien concept*'' (Dreze et al, 1997).

4.2.1.3 Increased Morbidity. People forced to relocate are more vulnerable to illnesses and serious diseases. Adverse health effects of displacement, particularly when projects do not incorporate preventive epidemiological measures are well documented (Singh, 1997). The direct and secondary effects of involuntary displacement without preventive health measures range from diseases caused by poor hygiene such as diarrhoea and dysentery to outbreaks of parasitic and vector borne diseases such as malaria and schistosomiasis.

Some examples of such outbreaks are as follows. At the Akosombo reservoir settlement in Ghana, the prevalence of schistosomiasis around the reservoir rose from 1.8% prior to resettlement to 75% among the adult lake side dwellers, and close to 100% among their children, within a few years after the impoundment (Asthana, 1996). An outbreak of gastro-enteritis occurred along the Victoria dam reservoir dam in Sri Lanka. At Nam-pong, a dam in Thailand, monitoring confirmed that local rates of morbidity from liver flukes and hookworm infections- were higher than provincial levels as a result of deteriorated living conditions and poor practices of waste disposal.

4.2.1.4 Food Insecurity. *"Forced uprooting increases the risk that people will fall into chronic food insecurity, defined as calorific protein level intake below the minimum necessary for normal growth and work. Sudden drop in food crop production and loss of harvest takes place due to disruption caused, and land lost due to resettlement. Rebuilding food production capacity at the relocation site may take years''* (Cernea, 1996).

One of the most common complaints of the affected persons regarding the new land is that it does not produce enough variety and quantity of edible grains to meet a family's yearly consumption requirements. Taking the case of Mapali village in the Narmada valley, it is seen that corn was the main crop, followed by jowar, urad, tuver, bunti, bhadi and muu, which could be grown in abundance and stored for decades as a safe guard against famines. But at the resettlement site, only jowar, tuver and kapas can be grown with low yields, the main reason being the failure of the affected persons to understand the importance of time bound agricultural methods (Dreze et al, 1997). The terrain in Mapali is hilly and slopes are cultivated without terracing. The hilly terrain allows the water to drain off so that ploughing, sowing and weeding can be done almost any time during the monsoon period. Agriculture is carried out on a loose time bound basis within the boundary of the monsoon months, hence most people can take time and even days off when they like, for drinking, visiting relatives or attending rituals. However, at the new site, the method of agriculture, the agricultural cycle and even the type of crops grown are very different, leading to confusion, low yields and general food insecurity.

4.2.1.5 Social Dislocation. Due to involuntary displacement, the social cultural and economic base of the families, which has been built over generations gets dismantled. The unravelling of social organisation structures, the dispersion of informal and formal networks, associations, etc., is an expensive yet un-quantified social loss (Cernea, 1996). This causes social dislocation and is one of the most important factors, which contribute to the impoverishment quite significantly. It compounds the individual loss with the loss of social capital, and the dismantled patterns of social organisations, which are hard to rebuild.

Studying the case of Vasava (Dreze et al, 1997) tribe in the Narmada Valley Project area, it is seen that the Vasava use their hamlets as the primary source of social interaction. Hamlets share a common water source and are largely family and clan based. The village acts as a social unit for individuals only at the main functions of Divaho and Holi. Membership of the same clan forms a far more important basis for social relationships than living in the village. The women continue to belong to the clan of their father, and are not considered a member of her husbands' clan even after marriage.

The Vasavas see the resettlement and rehabilitation as a process that initiates the restructuring of their social relationships. This is because the physical distance between them and the people of their social circle would increase. This fear is openly expressed by them and is one of the reasons why many attempted to complete the important social functions before they actually moved to the resettlement site. This social distance is the greatest for women who often consider this as the worst consequence of resettlement. They maintain a close relationship with their parent families even after marriage and often return home for social visits. They fear such interactions will no longer be possible after resettlement.

Vasava men maintain a very close relationship with their in-laws, and it is quite common for them to help their in-laws when labour is required or at other times of need. They regret that there will be a weakening of this bond following resettlement. It is argued that

although physical distance would increase the new sites would have public transport services. Therefore the actual time taken to commute between the resettlement sites is often less than it would have been to walk from one hamlet to another or from one village to another. However the villagers do not view these increased transport services as important. They say " *Of course we can take a bus and we hardly have to walk, but that is assuming that we have the money to afford*".

4.2.1.6 Joblessness. For several categories of people whose existence depends on jobs, including landless labourers, shopkeepers, shop workers and small businessmen, there is a tremendous loss of employment opportunities. The employed landless lose in two ways according to the World Bank, (Asthana, 1996); they lose access to land owned by others but sharecropped by them and, forego assets under the common property regimes.

A study of the Argentina-Paraguay Yacyreta project (Asthana, 1996) found a 17% unemployment rate among the displaced. In the Churchill-Nelson hydro-electric project in Manitoba (Asthana, 1996), Canada the economic activities of the resettled indigenous people were curtailed drastically.

4.2.1.7 Homelessness. Loss of shelter is temporary for most of those displaced, but for some families it remains as a chronic problem. In a broader cultural sense, homelessness is also placelessness, loss of a groups' cultural space and identity, or cultural impoverishment (Cernea, 1996). If resettlement policies do not explicitly provide for improvement in the housing conditions, or if the compensation for demolished shelters is made at assessed market value rather true replacement value, the risk of homelessness is increased (World Bank, 1993).

A study of the Cameroon Douala urban resettlement (Asthana, 1996) found that over 2,000 displaced families were hindered in their efforts to set up new permanent homes. At the Foum Gleita irrigation project (Asthana, 1996), Mauritania, only 200 out of the 881 displaced families reconstructed their housing, the rest living precariously for more than two years in tents or under tarpulins.

4.2.1.8 Marginalization. Marginalization occurs when families lose economic power and slide downward, middle income farm households do not become landless, but become small shopkeepers, and craftsmen are down sized and slip below poverty line.

In the Nepal Kulekhani hydro electric project (Asthana, 1996) it was found that the majority of the displaced people were worse off socially and economically, due to lower productivity of the new land and less diversified production. Marginalization also occurs through the loss of off farm income sources. In Sri Lanka's Kotmale project (Asthana, 1996), it has been assessed that marginalization occurred because opportunities for non farm income generation were lost or were limited through displacement, increasing the economic difference between the resettled people and the local population.

4.2.2 Category II: People Not Displaced, but Profoundly Affected by Large Water Resources Projects

4.2.2.1 Transmission Lines. Extra high voltage transmission lines are being installed in large numbers throughout the country because of its ability to transport more power. The electrical and magnetic fields generated by the transmission lines affect the humans and animals. Hair erection, feeling spark between the body and the clothes are visible phenomenon in strong fields but weak fields also have long term effects. A report was published (Dass, 1985) in erstwhile U.S.S.R in 1972 which indicates that lasting effort could occur in fields above 5kv/mt and it was recommended that the exposure of persons coming in contact of such fields should not exceed the following values:

(1). 3 hours/day --------- Field strength 10KV/m

(2). 1.5 hours/day --------- Field strength 15KV/m

(3). 10 min/day --------- Field strength 20KV/m

Although many countries have not accepted this figure, it is universally accepted that fields above 15 KV/m cause annoying effects (Dass, 1985)

Corona is formed in all the EHV lines. Phenomenon of corona continues as long as voltage is above critical voltage. The current becomes non-sinusoidal and contains higher frequency components along with fundamental frequency. These higher frequency components interfere with television and other frequency signals. Corona discharge also leads to the formation of ozone.

Depending upon air movements and atmospheric conditions the ozone formed can travel long distances and injure susceptible plants in near and distant areas. ozone can injure many plants, though the significance of this injury in terms of plant growth, development and yield has not been clearly and completely determined for any given plant.

4.2.2.2 Health Aspects. Even before Sir Ronald Ross incriminated mosquitoes in the transmission of malaria, there were remarkable unanimity of opinion regarding the cause and effect relationship between water resource project and malaria. Dampster, who was a member of a commission investigating unhealthiness associated with the western Yamuna irrigation canal stated, " *all our previous knowledge and experience would lead us to suspect some mischief from irrigating canals in such a climate as that of India especially if not expressly constructed so as to preserve the drainage of the country and effectually to control the immoderate use of water"* (Sharma, 1985). Similarly Macnamara (1880) wrote, *"Doctor Cutliffe in his report attributed the extreme prevalence of fever in many places where he visited after the rise in the spring level under the influence of the canal.* Another quotation from Macnamara (Sharma, 1985) concludes that a comparison of the statistics of towns in the irrigated and non-irrigated areas suggest that canals do exercise direct influence upon the prevalence of fever.

Water resources projects create large impoundment and inundation, and also change the characteristics and hydraulics of downstream flow, thus having significant impacts on the ecology and environment of the area. As a lake like system replaces the ecosystem of a river, it creates a new condition for various aquatic organisms. A possible effect may be loss of diversity and stability. Another effect is the increased primary productivity in an impoundment, creating eutrophic conditions, which stimulate excessive growth of algae,

aquatic weeds, bacteria etc. This has significant impact on the water quality, not only in the catchment area, but also on the downstream river and canal. In many areas of the country (Sharma, 1985) it has been observed that opening of canals has brought malaria to healthy areas. Commonly encountered reasons for irrigation malaria are the rise of subsoil water resulting in water logging, poor drainage, etc. Minor engineering aberrations, such as leaky sluice gates, seeping canal banks, borrow pits, defective distribution chambers, improper delivery of water, poorly maintained canals bank and beds, absence of sufficient numbers of bridges, general water untidiness, absence of controlled systems of field channels, increased wet irrigation, lack of coordination between different agencies etc., can also result in unhealthy situations. Canal irrigation provides most favourable and extensive breeding grounds for mosquito proliferation. Sharma and Mehrortra (1982) point out that irrigation increases the average humidity of the atmosphere thus making the region more conducive to mosquito survival (Singh, 1997). Villages bordering canals have a very high incidence of malaria, whereas in villages with tube well irrigation the incidence of malaria is very low. Besides malaria, the water resources projects also influence the transmission of other vector borne diseases such as Filariasis, Japanese Elephentatis, Dengue etc. Clyde (1931) reported from Sarda canal headworks that, "*It is remarkable that at the very beginning of the work, Culex mosquitoes were practically non existent, but with the opening of the forest and construction of camps a certain number begins to appear. They never, however became numerous, it being the exception to catch 10 culicines for every 500 anophelines. The chief breeding places of these culicines were defective soakage pits and swamps contaminated with faces.*" Recent studies by the Malaria Research Center (Sharma, 1985) in the same area have shown that Culex population has increased tremendously. In addition, infected labourers drawn from endemic areas of eastern Uttar Pradesh and Bihar regularly bring Wucheria Bancrafti infection, and over the years the area has become endemic for Filaria.

Apart from Malaria and Filaria, studies conducted by the National Institute of Nutrition (NIN) point to the spread of other diseases like Fluorisis around the Nagarjunsagar, Parambikulam-Aliyar and Hospet dams (Singh, 1997). NIN's interpretation is that

"Water seepage from the dam's reservoir and canals have increased the level of the sub-soil water. As a result, the alkalinity level of the soil has increased. This in turn has changed the fluoride, calcium and trace metal composition of the soil, thus aggravating fluorisis in its pristine form and in a new dimension in the syndrome of knock-knock disease (Singh, 1997) ". Another common disease connected with water projects is, Schistosomiasis caused by parasitic flatworms, the larvae of which develop within the bodies of the fresh water snails and get transmitted to humans when they come in contact of such infected water.

4.2.2.3 Agriculture, Cropping Pattern and Associated Pollution. Due to increased water supply, a gradual change in the cropping pattern is observed. Farmers slowly switch towards more water intensive crops as regular supply of water is ensured. The changes in cropping pattern take place not only in terms of more production of water intensive crops, but also cropping mixture. It is well known that every crop takes certain nutrients from soil and leaves behind some others. A judicious mix or an interchange of crops prevalent in earlier agricultural systems made sure that the soil fertility was maintained. The over reliance on mono-cropping results in the drain of certain salts required by that particular crop. Using chemical fertilizers makes up this deficiency in nutrients. Mono cropping of plants also increases the risk of destruction of crops by pests and weeds. The consequent use of chemical fertilizers and pesticides upset the physiochemical and biological balance of soil. Chemical fertilizers and pesticides also pollute the surface and ground water, leading to a chain of health related problems.

Agricultural lands are often waterlogged due to flooding of the plant root zone by high water table. Plant nutrients like nitrates are fixed by nitrifying bacteria in the soil. These bacteria need oxygen for survival, the supply of which is cut off when the land becomes waterlogged (Garg, 1995). Water logging may occur due to various factors, some of which are; over and intensive irrigation, seepage of water through canals, inadequate surface drainage, inadequate natural drainage, excessive rains, submergence due to floods, and unfavourable topography

Large water resources projects affect not only people who are directly displaced, but also people living around the project area who are not displaced. Such people are identified as category II people in this text. Category II people as defined, can further be subdivided into several distinct categories; the existing population in the area of resettlement of category I people, population in non-submerging hamlets around reservoir rim, population along the river downstream of the dam, and population in the project catchment area. Various adverse impacts on these populations will now be discussed in a case by case basis.

4.2.3 *CATEGORY IIA: Adverse Effects on the Existing Population in the Resettlement Area.*

In resettlement planning the displaced people cannot be considered in isolation. The relocation of displaced people is likely to have impacts on the host population including employment, use of common property resources and pressure on natural resources or social service. Conflicts between hosts and resettlement implementation agency may arise if the displaced people are compensated. Taking the example of the Somaval settlement in the Narmada valley area it is seen that a forest has been cleared for resettlement and rehabilitation purpose. This forest contains unrecorded settlements where the original residents depended upon the forest for their sustenance. The displaced people are required to adjust to both the host villagers and the residents in the unrecorded settlement, as members of the latter have now to share their minimal resources with an additional population. Hence, tension has been noted in these areas. In Somaval, one of the resettled persons had his crop stolen. Some resettled people have also been physically threatened by earlier inhabitants (Dreze et al., 1997). The resettled people receive benefit in the form of agricultural implements, fertilizers and other infrastructural support, as specified in the compensation package. Even though these are insufficient in most cases, it has created feelings of jealousy and hostility among the original inhabitants, since the host population does not enjoy these benefits.

In most resettlement colonies in the Narmada valley area inhabited by the displaced people from Gujarat, the integration with the host villages is yet to be attained. Except

for the site of Khadaga, problems have been identified in the other sites (Dreze et al., 1997). These relate to a variety of factors. A large number of host population, employed as labour by the absentee landlords suddenly lost their means of employment as the land was purchased by the resettlement and rehabilitation department and the displaced people resettled there. The resettled people, unlike the absentee landlords, do not require the services of these labourers, as they cultivate their field with the help of family members. In addition the arrival of so many people has created a situation of surplus labour, reducing job opportunities for original population. It may be mentioned that one of the objectives of the resettlement and rehabilitation plan is that the resettled people shall be fully integrated in the community to which they are resettled. But 'integration' is a complex issue and is closely if not solely related to the economic opportunities and the infrastructral amenities available to both the populations. Integration of the displaced persons with the host population is essential in most cases, as they have to share common services such as medical centers, shops, schools, burial grounds, etc. Some studies point out that, though various factors contribute to developing close social relations, the physical distance between the resettlement sites and the host villages play an important role.

4.2.4. *CATEGORY IIB: Adverse Effects on People in Non-Submerging Hamlets.*

In the Narmada valley project except for a few villages in Gujarat and Manibeli village in Maharashtra, all other villages will not be fully submerged (Dreze et al., 1997). A few hamlets are to be left out in each village. The people who reside in these non-submerging areas are not being resettled. They will be left behind in an inaccessible mountain area around the rim of the reservoir. For the non-submerging hamlets in Maharashtra, access to Gujarat will be completely cut off. Villages along the Narmada river are dependent on Gujarat for its market and for a range of social reasons. Markets on the Maharashtra side are located at a greater distance from these hamlets. People living in these truncated villages are likely to be affected by water borne disease generated by the reservoir. They will have minimal access to health care and even this would become inaccessible in the monsoon season. These isolated hamlets thus do not constitute viable units, and their survival cannot be assured.

4.2.5 *CATEGORY IIC: Adverse Effects on People Downstream of the Dam.*

Creation of the reservoir has its effect not only on those who are living upstream but also on those who are living downstream of the dam. Some of the adverse impacts of the dam construction, which are visible in the down stream section of the river are as follows;

4.2.5.1 Pollution by Agro-Chemicals, Domestic and Industrial wastes. Since the farmland on the banks of the river is no longer flooded in the rainy/wet season as it used to be before the construction of the dam, there is a lack of fertile soil input on the flood plains. To maintain the fertility of the soil the farmers are left with no option other than to put large quantities of artificial fertilizers, which is a financial burden to them. The experience in almost all the irrigation projects have shown higher use of agrochemicals. The vulnerability of new high yielding varieties of plants to diseases and the extension and intensification of agriculture in dry land has resulted in 3 to 4 times increase in the use of pesticides and herbicides (Singh, 1997). The contamination level of drainage water and toxicity of residue depends on the dosage and frequency of use as well as on the type of agrochemical used. Frequent applications and high use of pesticides not only threaten public health, fish etc. but may also cause drug resistance in certain pest species. Frequent use of fertilizers tends to distort the nutrient balance of drainage water affecting the survival of indigenous plants and animal species. High level of nitrates, chlorides and phosphates can make water unsuitable for human consumption.

The industrial and domestic effluents are all discharged downstream which, owing to the reduced discharge, does not have sufficient carrying capacity to assimilate the waste, resulting in the degradation of the water quality. This results in increased cost to downstream communities for water treatment. Sometimes this water is so polluted, that alternative water sources, i.e., groundwater reserves have to be tapped, resulting in over exploitation of groundwater in many cases (Singh, 1997).

4.2.5.2 Fisheries and Other Aquatic Life. The formation of reservoir due to the construction of dam is accompanied by a depletion of fish catch downstream. This may cause an enormous reduction in the availability of the protein to the local populace downstream of the dam. It may also lead to the loss of livelihood of the fishermen in these areas (Singh, 1997).

The increasing pollution in the rivers due to modern agricultural practices such as indiscriminate use of artificial fertilizers, along with decreased flow in the downstream affects the water quality, which further deteriorates due to domestic and industrial pollution. Many aquatic animals die in such polluted waters and those who survive contract various diseases as toxic elements get accumulated in their bodies. Such aquatic animals may be harmful for human consumption.

Due to decrease in the fish catch there is a tendency among the fisherfolk for uncontrolled and over exploitation of fisheries. Although there are rules regarding where to catch, how much to catch, when (season) to catch, they are never followed strictly resulting in the extinction of various species. The common example being that of Natopteras Chetala which was once very common in Assam, Bihar and Uttar Pradesh is now nearly extinct due to over fishing (Thakur, 1994).

4.2.5.3 Dam Failure. The possibility of dam failure due to construction related problems and earthquake is an area of grave concern. The international commission on large dams (INCOLD) has reported that during the last 175 years, over 600 dam failures and related incidents have been reported worldwide (Singh, 1997). In other words about three dam failures occur worldwide every year. Earthquakes are the cause of about one percent of these failures and wars only three percent. Fundamental problems like inadequate spillway, poor construction and uneven settlement cause eighty five percent of the dam failures (INCOLD, 1974). Seismological disturbance or the possibility of earthquake is a serious problem associated with large dams. A French seismologist, Rothe has considered the problem to be very grave and strongly advises against the tapping rivers. " *By building dams, man is playing the sorcerer's apprentice. In trying to control the energy*

of the rivers, he brings out stresses whose energy can be suddenly and disastrously released (Rothe, 1978).

However there is another group of experts who claim that dams, when properly designed can withstand earthquakes, and are not responsible for inducing earthquakes. On this point, the international symposium on Earthquakes and Dams held in May 1987 had concluded; "*dams designed by modern techniques and build according to the latest specifications have considerable reserve strength and can withstand severe earthquakes. They have been shown to resist earthquakes well compared to other man made structures (Bhagirath, XXXVIII). The world's highest dam is NUREK of U.S.S.R., which is 300 meters high earthen dam. This dam is situated in a very high seismic region and has safely with stood a seismic shock of intensity over 7 in the Richter Scale. There are thousands of dams all over the world, which are over 150 meters high, but hardly any damage to them has been reported due to earthquakes. It has been significantly established that the dams using modern methods of design and construction can safely withstand high intensity earthquakes, while dams not using this technique can be damaged even with earthquakes of quite a low intensity*".

Major earthquakes have occurred in some large reservoir regions in India. However, there is no agreement among experts regarding whether these were reservoir induced. An example of a major earthquake in a reservoir area is that of Koyana earthquake, which occurred on 10th Dec 1967. This earthquake was of 6.5 magnitude on Richter scale. Its epicenter was 45 km southeast of Bombay. This region had long been a non-seismic one and according to the experts has experienced a series of tremors after the construction of Koyana dam reservoir in 1962 (Doria, 1990). Some other significant instances of earthquakes near large dams are at Rahanagri in the same year and at Mula and Parambikulam in 1972 and 1963 respectively (Singh, 1997).

Some experts feel that the Tehri dam, which is under construction in Uttar Pradesh, has the potential of either inducing seismicity or crumbling in the face of one. This dam is located in the highly seismic Himalayan Zone. According to the government the failure

of large dams due to dam induced earthquakes is only a fear which is unnecessarily being projected manifold by the local leaders, politicians, NGO'S and the local media for their own interest. In context of Tehri dam, the government cites the example of Bhakra, Ramganga, Panda and Tarbela dams, which are all constructed in highly seismic Himalayan zone but has not induced any seismicity.

4.2.5.4 Water Management and Flood Protection Construction of dams result in reduced water flow in the downstream, which has far- reaching effects on the people. Improper dam water management may cause problems in the downstream regions, as explained below. During dry season there is an increased demand for water for agricultural, domestic, and the industrial sector. The dam authorities do not release adequate amount of water during this time, as they are under pressure to save water, which can be used to generate electricity. However during the wet season water is released in large quantities. This results in flood like conditions and increases the problem of water logging and salinity in downstream areas. This does not imply that dams help in inducing floods. It is because of the improper management that such a problem arises.

4.2.6 ***CATEGORY III: Adverse Effect on the Regional Population***

Most of the effects of project implementation are beneficial for this group of population. In effect, these people enjoy the benefits of the project, while the people belonging to other categories suffer the adverse consequences, or the associated costs. However, two long-term adverse impacts of large water resources project implementation on the category III population is mentioned in the sections that follow.

4.2.6.1 Water Logging and Salinity in the Command Area. An agricultural land is said to be water logged when it's productivity gets affected by high water table which floods the root zone of the plants and thus makes them ill aerated. The life of the plants depends upon nutrients like nitrates, which is produced by bacteria by the process of nitrification. These bacteria need oxygen for survival the supply of which is cut off when the land becomes waterlogged resulting in death of these bacteria and fall in the

production of plant food (nitrates) and consequent reduction in the plants growth and hence crop yields are reduced (Garg, 1995). It may occur due to various factors, such as over and intensive irrigation, seepage from unlined canals, inadequate natural/ surface drainage, excessive rains and irregular topography. This problem of water logging hinders in the normal cultivation operations such as tilling, ploughing etc. Certain water loving plants like grass weed etc., grows profusely and luxuriantly in water logged lands thus affecting and interfering with the growth of crops.

Water logging leads to salinity as in such cases the plant root comes in contact of the capillary fringes and is continuously evaporated. Thus a regular upward flow of water from water table to land surface gets established. With this upward flow, the salts, which are present in water also, rise towards the surface, which has a corroding effect on roots by reducing the osmotic activity of the plants and checking the plant growth. Such a soil is called saline soil. Thus water logging ultimately leads to salinity resulting in reduced crop yields. For this reason salinity and water logging are considered as twin problems.

4.2.6.1. Water Rights Dispute

Often a river will pass through two jurisdictions. In such cases both the parties have claims on the water. Such jurisdictions may be two countries, e.g., India and Bangladesh sharing the Ganga water, or India and Pakistan sharing the water of the Jhelum river. Often two or more states in India may share jurisdictions, e.g., Maharastra, Gujarat and Madhya Pradesh on the water of Narmada, or Karnataka and Tamil Nadu on the water of Cauvery. In such cases, when a large water resources project is planned, different jurisdictions may lay claim to the water from the resulting project. Such disputes are quite common and may take years to resolve. Additionally, some tension and ill feelings may occur between the populations with competing claim on the river water.

4.3 Beneficial Impacts of Large Water Resources Projects

It must be bourne in mind that the beneficial impacts of large water resources projects are many. In recent times such projects have been heavily criticised in the media and other quarters due to their adverse effects on socio-economic and physical environments. Such

criticisms are often one-sided, and tend to highlight only the adverse effects of such projects. In this section, an attempt has been made to point out the numerous beneficial effects of such projects. Other than the obvious and direct benefits, one must bear mind the indirect effects of such projects on economic development of the region. The protagonist of the dam say that such projects act as an engine for economic development of a region by efficiently exploiting the available natural resources for the benefit of the regional population.

4.3.1 *Benefits to the Local Population*

"Local population", in this context would mean people of the categories I and II mentioned previously. Recent migrants into the project area, who are incorporated in category III nomenclature of this report, are also included in the definition of "local people". Benefits to local people may be broadly divided into twelve categories, viz., direct economic development, indirect economic development, education, medical facilities, transportation, tourism, recreation and entertainment, irrigation, flood control and land reclamation, public safety, sanitation, public utilities, and government administration.

4.3.1.1 Direct Economic Development. Commissioning of large water resources projects enhance the economic activities in a region. This activity is related to the construction, operation and maintenance of the infrastructure created. People of category I and II get some benefits from such activities, especially the people who are given jobs in the project as a part of the compensation package. However, the main beneficiaries are the recent migrants to the project area, who come specifically to partake in project related employment. These category III people obtain maximum benefits from the direct economic development of the region. During the construction phase, civil engineering contractors import labour from far off places. Job involving some skill and experience such as those of engineers, technicians, welder, fitter etc. go exclusively to the outsiders, as locals in most of the cases do not have the necessary experience, training or education (Dhawan, 1990). During the operation and maintenance phase most of the official and clerical posts are occupied by the outsiders while locals get petty jobs like those of watchman, sweeper, driver, lineman, daily and casual labourers, etc.

4.3.1.2 Indirect Economic Development. Due to the implementation of large projects, and the resulting investment, an indirect economic boom is often seen in the region. These aspects are explained in greater detail in section 4.3.2.5. Unfortunately, most of the benefits of such development are obtained by the recent migrants to the area. However, proper government affirmative action programs for incorporating the existing local population in the economic mainstream of the region may enable such people to improve their living standards, which is most desirable as these people pay the real human cost/price of the project.

4.3.1.3 Educational Facilities. Large development projects generally stimulate the construction of new schools, colleges, and other vocational institutions. This is partially due to a sudden increase in the student population, which occurs due to the influx of recent migrants to the area. General economic development of the are will also result in an increase in demand for educational facilities. However, the number of schools and colleges so established cannot be seen as an indicator of the standard of education in that area unless it caters to the needs of all the sections of the society, irrespective of their status.

4.3.1.4 Medical Facilities. Large development projects generally stimulate the construction of new hospitals, clinics, medical laboratories etc., in the project area. However, the benefits from these facilities are mostly accessible to the recent migrants to the project area, who are directly connected with the project construction and operation. Generally, such health facilities give preference in all respects to the project employees and charges high amount of fees from the existing local population which is not affordable to them. Thus, improvement in the existing medical infrastructure will be of any great significance, if and only if it is accessible to all sections of the population.

4.3.1.5 Transportation Facilities. Large development projects generally result in additions to existing road and rail networks and construction of airports. This

infrastructure development is partially due to the direct effect of the project construction and influx of migrants, which necessitates augmentation of existing transportation networks (Canter, 1996). Indirect economic development as a result of the project implementation is also partially responsible for improvement of transportation facilities.

Increasing economic activity in the project area result in increase in the traffic flow, and may lead to traffic congestion, etc, in spite of the augmentation of the transportation network. This is often cited as a drawback of such developmental activity.

4.3.1.6 Tourism, Recreation and Entertainment Facilities. Reservoirs often have exceptional scenic value to the landscape, providing visual enjoyment and aesthetic refreshment. Recreation on such water bodies is popular all over the world.

For example, the Bhakra-Beas complex provides man made lakes at Beas and Bhakra dam sites and balancing reservoirs at Sundernagar and Pondoh. These lakes have become a source of attraction to tourists and holiday seekers. The beautiful landscaping around the Bhakra and Pong reservoirs emanates charm and generates an atmosphere of peace. The spillway, a man made cascade, when in operation, rolling huge sheet of rolling water with tremendous velocity, attracts the visitors. Pong reservoir is also the home for new varieties of fish and attracts the Indian and foreign anglers. It has been the venue of all India level fishing competition. Mountaineering and allied sports departments of Himanchal Pradesh government have set up a water sports center at Pong reservoir which imparts training to young men and women in swimming, water safety and rescue, canoeing, sculling, rowing, surfing and skiing, waterpolo, river rafting, surf board sailing, etc (Sukhani, 1991).

Developmental activity may also lead to an increase in the availability of entertainment facilities like movie theaters, video parlors, sports activities, theatre, concerts, etc. This will undoubtedly enhance the quality of life of the local population.

4.3.1.7 Irrigation Facilities. Construction of the dam and the associated canal system may help the local farmers whose land until the dam construction was without irrigation. For a detailed discussion of this aspect of large scale water development projects, readers are referred to section 4.3.2.3.

4.3.1.8 Flood Control and Land Reclamation. Examples will be cited to illustrate the beneficial effects of dams in water management. The example of the Kadna dam in Gujarat shows that it affords partial flood protection to the down stream areas in the Panchmahal and Kheda districts as a result of planned and controlled reservoir operations (Singh, 1997). Before construction of the dam, floods of varying intensity and magnitude had been very common in the areas downstream of the Kadana. This safety against the floods resulted in substantial flood plain development. Easy availability of water and power along with increased infrastructure and communication facilities attracts industries and other economic and commercial activities in the area. Another example is that of Beas river, which had a historic highest flood of six lakh cusec in 1947. This unleashed havoc on life and property in it's basin. Since the construction of the Bhakra dam, the project has averted many floods (Sukhani, 1991).

The dams not only absorb floods, but convert the destructive power of water to constructive uses. The river water once going waste to the sea and causing havoc through floods during monsoon is now a boon for irrigation and industrial development. Various dam projects have made Green Revolution successful and have helped in pulling out the agricultural economy of the region from a quagmire of poverty to a buoyant stage. Lush green fields, bumper harvest and live chimneys in the industrial areas besides millions of lighted homes bear ample testimony to the benefits that these giant power projects have bestowed on millions of people. In addition, controlled flow of water makes it possible to reclaim vast lands along the sides of the rivers, which earlier lay desolate due to the potential of devastation by monsoon floods.

4.3.1.9 Public Safety. Large influx of recent migrants into the project area, mostly related to project related employment, results in increased antisocial activities related to excessive drinking, prostitution, etc.

In addition, these recent migrants are far better off than the local population. They have the ability to purchase not only essential goods but also items of luxury. This creates jealousy among local youth, who live outside the project township but are regular visitors to township as they supply milk, vegetables, food grains or work as servants, maid servants, watch men, gardener etc. This result in increased antisocial activities like theft, burglary, dacoity etc.

The impact on police and fire protection services due to development can generally be divided into two categories, namely, a change in the level of activity requiring such protection, or a requirement for new facilities and personnel to provide the necessary level of protection (Rau, 1980). The developmental activity may affect the crime rates in the community by adding or removing targets (people, business, residence, etc.) and by changing the physical or social conditions that may breed crime or make crime easier to commit. Crime attracted by development may spill over from the existing community or the new development may attract the crime away from the existing community.

With regards to impact on the level of fire protection activity due to development, there are two basic considerations, the change in the likelihood of the fire getting started and the change in the likely spread and risk to the life once fire is started. Fire incidence may be affected by many aspects of new development such as type of construction and materials, equipment's, activities in development, sauce economic characteristics of occupants in general and the character of the previous development. These factors can also potentially affect the likelihood of fire spread, which is also influenced by factors such as overall design, street layout, and proximity of buildings to each other.

In conclusion, a general increase in the number of police personnel, and associated infrastructure is noticed. Similar improvement is also noticed regarding fire protection services. However, even the enhanced capacity of these services may sometimes be overwhelmed by the increased demand for these services

4.3.1.10 Sanitation. Development projects in remote areas invariably lead to the construction of residential colonies. Some of these may be for the persons directly employed by the project, and some for people employed in the secondary and tertiary sectors. Generally the project colonies are well planned, having a good sewerage system. This may lead to extension of sewer network in other colonies also, leading to a general improvement in sanitation (Rau, 1980).

However, in many cases, other residential colonies are not so well planned. Even if the project authorities develop some colonies as a part of the resettlement and rehabilitation package, the old habits of the existing population to relieve themselves in the open does not change easily. This causes sanitation problems, as there is not enough open spaces in the new colonies. It has been reported from many such colonies that people use the toilets as a storehouse for keeping fodder for the cattle.

4.3.1.11 Public Utilities. This is an important aspect in assessing the change in standard of living of the affected persons. Factors which must be taken into consideration in conducting the analysis of this type include the increased access of the population to electricity, piped water, sewer connections, cable television, newspapers, garbage collection, liquefied petroleum gas cylinders for cooking, telephones and other telecommunication services, fire brigade, etc.

4.3.1.12 Government Administration. With the setting of the development project there is an increase in the population, traffic flow economic and commercial activities and services of such kind. To maintain such services effectively there is an increased establishment of the government offices and departments. These may include courts, police stations, and other administrative offices. This is beneficial for the existing

population, as many routine matters, for which people had to go to the nearest administrative centres, can now be taken care of locally (Canter, 1996).

4.3.1 *Benefits to the Regional Population*

Benefits from large water resources projects are mostly obtained by the category III people. This includes the regional population, which is not present in the immediate project area. Water resources projects generally increase the prosperity and economic development in the region. Investment in water resources project will create many direct jobs, and associated demand for goods and services. In addition, it will create infrastructure, i.e., power, roads, railways, water supply and distribution networks, etc., which will act as an engine for further industrial development and economic growth. The regional population around the project area, however, mostly enjoys benefits of such growth. Various aspects of the beneficial impacts are now discussed in some detail for further elucidation of the points made above.

4.3.2.1 Drinking Water Supply. Due to the burgeoning population in Indian towns and cities, supply of drinking water to population centers is becoming critical. Often this water is not available locally, and has to be imported from far off places.

For example, the entire water supply of Bombay is dependent on a series artificial reservoirs created by damming small rivers, viz. Vaitarana, Tansa and Bhatsa. There is an additional proposal to construct another dam on Vaitarana to meet the increasing needs of Bombay's water supply. Water requirements for Pune city is met from the Panset and the Khadagwasla dams. Hyderabad is mainly dependent on its water supply from Manjira and Singur dams. Delhi, which is situated on the banks of Yamuna, gets hardly 25% of its water supply from Yamuna. The balance is met by the water from the Bhakra dam in the west and Ram-Ganga dam on the east. For the future needs of Delhi, it is proposed to obtain water from the Tehri dam being constructed in the north. This is in addition to a number of tubewells, which contribute nearly 10% of the Delhi's water supply. Madras depends on the Poondi and Srisailam reservoir for its water supply. The acute scarcity of water supply in Madras and salinization of its ground reserves, due to

ingress of seawater is well known (Dhawan, 1990). It is apparent from the above discussion that many large Indian cities are largely dependent on artificially stored water in reservoirs for their water supply. As local sources dry up, and underground reserves deplete, dependence on water from artificially created reservoirs are surely going to increase.

4.3.2.1 Industrial Water Supply. Although the industrial requirement of water constitute only a small percentage of a total consumption of water, in many industrial applications water is needed in bulk quantities. This requirement cannot be met without the construction of storage dams. For example, to meet the water requirement of the Bokaro steel plant another dam at Tenughat in the Damodar river basin had to be constructed. Similarly a cluster of thermal and super thermal power plants in Uttar Pradesh are entirely dependent on the water stored in the Rihand and Obra dam in the Mirzapur region (Dhawan, 1990). Easy availability of water enhances the industrial growth and hence the economic activities.

4.3.2.3 Irrigation Water supply. India is a tropical country with vast diversity of climate, topography and vegetation. Rainfall varies considerably from place to place, and it is often erratic, causing flood and drought. Crops cannot be raised successfully over the entire land without ensuring the supply of water when and where required. Hence it is necessary that artificial irrigation facilities be ensured. It is here that the usefulness of dams becomes apparent. With the help of dams we can store and divert the river water to irrigation canals. The Green Revolution that took place in Punjab, Haryana and western Uttar Pradesh, partly due to enhanced irrigation facilities created by Damming rivers (Garg, 1985). Irrigation surely leads to an increase in food production, through the increase in productivity of the agricultural lands. This is of primary importance in a country like India, where increased food production is of primary importance, considering the rapidly growing population. Additionally, the revenue returns on irrigation are sometimes quite high and help in all around development and prosperity of the country. Canal falls can be used for power generation. Ganga and Sarda canals constructed for irrigation are generating about 80,000 kilowatts of electric power (Garg,

1985). Irrigation canals are generally provided with embankments and inspection roads. These inspection path provide a good road way for villagers for walking, cycling or some times even for motoring. Large irrigational canals can be used and developed for navigational purpose. Trees are generally grown along the banks of the canals which increases the timber wealth of the country and also help reduce soil erosion.

4.3.2.4 Hydroelectric Power. The role of power in the national economy is well known. The per capita consumption of power is one of the indices of the national prosperity. As per the long-term national power plan formulated by the Central Electricity Authority, the country will need about 174600 MW of power by the end of this century (Ghosh, 1991). Which means that additional growth of about 10% every year during the entire period will be necessary. The hydropower plays an important role in augmenting this power supply. The hydro electric potential of the country is estimated to be about 442 million units of firm annual energy and 84044 MW of firm power at 60% load factor. Unfortunately the installed capacity in hydropower is only 17650 MW which is only 13.6% of the ultimate potential (Ghosh, 1991). This suggests the importance of speedier exploitation of hydro-electric power in future. It is well known that hydropower is totally pollution free. Unlike the thermal power, which needs coal as a fuel, hydro-electric power uses water, which is a renewable source. Also, the cost of generation of hydropower is less as compared to the thermal and nuclear power.

4.3.2.5 Indirect Economic Development. Perusal of the reasons for the overall economic development of India over the last few decades reveal that there exists a close relationship between the water resource development and prosperity. Availability of adequate water and power, along with new agricultural technology, leads to rapid growth in the agricultural sector. This leads to an increasing demand in consumer and other goods, which in turn stimulates growth in other sectors. The interdependence of the production activity arises from the fact that each production activity demands input supplied from other production activities. A sector is linked with other sector which supply inputs to it and also those which use outputs as their own.

The linkages induced by the input demands and those induced by the output supply thus generate growth impulses that are transmitted from one sector to another (Dhawan, 1990). As regards link to manufacturing industry, a shift to improved technology in the agricultural sector creates demands for inputs like chemical fertilizers, pesticides, irrigation pumps and motors, improved implements and other agricultural machinery.

The growing demands for these inputs in turn leads to setting up of industrial units for manufacturing these inputs, as well as establishment for servicing and repairs of machinery and implements, thereby generating additional employment opportunities in the non farm sector, generating additional income. This gives rise to agro-based industries as well as other small scale industries by attracting additional income generated.

The development of capital intensive industry as well as increased surplus agricultural production also requires adequate and extensive transport system to move raw materials and finished goods, communication, housing, wide spread and efficient wholesale and retail network and many other allied services and utilities (Dhawan, 1990). In fact, in early stages of development services and utilities, which provide vital infrastructure for industrial development may grow even faster than industry in terms of both employment and income.

The increase in crop output provides adequate feeds and fodder for livestock and thus accelerates animal husbandry. Besides, construction of the reservoir promotes fisheries and forestry to a greater level. All these obviously results in greater income which could create a demand for additional production and distribution service to handle and process the increased output and deliver the final product to the consumer. In addition to the new employment generated in storage, transport, processing and distribution of greater output of the agricultural sector including crop and animal husbandry, fisheries and forestry; construction of infrastructure facilities like roads, storage go downs, transmission lines etc.

The increase in personal disposable income also creates demands for services like transport, communication and recreation. The increasing preference for consumer durable like cars, scooters, refrigerators, radio, television, etc. also need the services catering to their repair and maintenance.

4.3.2.6 Navigation. Waterways can be used as a cheap means of transport. Before the invention of rail and road transport, water was the only means of communication between distant places. Even today cargo too heavy to be packed on wagon trains or trucks is transported through big ships. The chief requirement for navigating through a waterway is the availability of sufficient water depth. A minimum water depth of about 2.7m is required for navigating safely and economically (Garg, 1995). At many places in the Indian rivers such a depth is not available hence various engineering measures such as ship locks and other navigational installation are required to ensure proper navigability of the channels. The construction of dam provides good depth of water in the upstream for the navigation purpose. All these constructions on river facilitate river traffic that may well have been constrained by low river flows, rapids or floods conditions in the natural river state. The extra commerce created by the increased navigation is generally advantageous to local economy. Lock dues generate income for the project, some of which can be allocated to local advantage. Provisions of services to passing ships provides another opportunity for generating local income and reservoir shore development is further encouraged by availability of cheap transport. Unfortunately there is no river in India running from north to south or viceversa. Most of the Indian rivers run from west to east or from east to west. This is a major handicap in the development of navigation in this country. Although there are about 15,000 km length of navigational waterways in India, but most of them are in a bad condition due to silting and poor maintenance and are fit only for boating except for 2500 km length in which streamers can ply. But out of this only 8000 km is on rivers and rest 7000 km is on canals and backwaters (Garg, 1995). Most of the navigable waterways exist in Ganga and Bhramputra rivers and their tributaries.

CHAPTER 5

DESCRIPTION: A CASE STUDY OF THE OBRA REGION IN SOUTHEASTERN UTTAR PRADESH

5.1 Purpose of the Study

The discussion in chapter 4 focussed on the various types of socio-economic impacts that may follow from the construction of large water resources projects. The socio-economic impacts discussed in chapter 4 were derived from the perusal of a large body of research work published on this topic. This serves as a secondary source of information for this report. Verification of these secondary data was necessary for validation of the impact factors. This was to be achieved by gathering first hand data or primary information on various impact factors. With this purpose in mind a field trip was undertaken in the Obra project area for gathering first hand information about the affected persons. The data collected from this field visit are presented in the next sections.

5.2 Description of the Study Area

Obra was a small hamlet on the right bank of river Renu until 1960, administratively a part of village Billi-Markundi, Tehsil Robertsganj, in the district Mirzapur, Uttar Pradesh. Now it is a part of newly created Sonebhadra district. It's geographical location is 24°34' N Latitude and 83°03' E Longitude. It is 125 Km from Varanasi and 110 Km from Mirzapur. This site was chosen for the construction of a cement concrete dam across the river Renu. The purpose of this dam was the subsequent installation of a peaking hydro electric power station based on the water releases from the main Rihand dam some 40 Km upstream. The construction work started in the year 1962-63 and was completed by 1969-70. The installed capacity of the hydro-electric power plant is 99 MW, with three units of 33 MW each. The plant was fabricated and installed by Bharat Heavy Electricals Limited. When the work on the dam was in progress, it was decided to build a thermal power station in the vicinity due to abundance of coal in the region, and expected availability of water from the Obra dam. Today the reservoir created by the dam is the main source of water for the thermal power plant, which has a capacity of 1550 MW.

5.3 The Village

Construction of the Obra dam led to the submergence of large tracks of land upstream of the dam. The village most affected was the Panari, which consisted of 48 tolas (sub parts) out of which 20, which were very close to the river, were completely submerged. All these tolas have been located in the attached map. The Renu river flows in the valley formed with the Vindhyachal Mountains on both sides. As the land was submerged, the villagers moved up the hills and established their tolas with the same name. However these tolas were not officially recognized as providing land was not the part of the compensation package at that time. Thus the villagers were officially encroaching on government land. A court case on this issue is still pending in the Allahabad High Court.

5.4 Field Study Protocol

An interview schedule was prepared keeping in mind the various categories of people, and information was collected from the affected persons. A typical directly affected person would be above 50 years of age, and long time resident of the area. Such people would have experienced both the pre and post-project conditions, and hence are in an ideal position to provide relevant and exact information. An analysis of the response given by such people led to the following observations.

5.5 Condition of the People who were Displaced Due to Project Implementation

This category consists of people who were displaced, and hence adversely affected by the project implementation. 233 families in the 20 tolas (with an average of about 10 to15 family members per family) have lost their land totally. There was no partial loss of land. There was no provision of providing land as compensation in 1960s, when this project was implemented. These people were instead paid Rs 50/- per Bigha of land and Rs 500/- for home. No compensation was paid for any other losses.

Before project implementation, land was the main source of livelihood for these families. In addition to farming, about 10% of the people practiced other occupations such as that of shopkeeper, cobbler etc. After the project implementation, having lost their lands due

to submergence, these people encroached upon forest-land on the hills. But this land was infertile, and hence insufficient for adequate food production. As a result, now about 50% of the adults in each family, amounting to about 1800-2000 persons, work as labourers, either in the stone quarries that have come up in the area, in the power plant or as domestic servants. The economic condition has improved for only 24-25 families. This is because one or more members of such families have obtained regular jobs in the project. However, these jobs were obtained by the concerned people on their own merit, and not due to any rehabilitation and resettlement package of the government. Such persons do not reside in the village but live in the project colony. For the rest the economic condition has either stagnated or deteriorated.

Before the project implementation, there was dense forest in the project site with all sorts of wild animals, and trees with economic value such as that of Sisham, Sakhu etc. The forest met the requirement of the villagers for wood, honey, flowers, medicines, grazing land and much more. But now due to encroachment of forest-land as described earlier, the forests are in severely depleted condition. Thus these people have to purchase items like firewood from the market. This extra economic burden is often intolerable. This has resulted in illegal procurement of firewood from forest department land, leading to further depletion of forests. Before project implementation, each family had about 10 heads of cattle on average. However, presently, it is difficult to maintain even 3-4 heads of cattle due to lack of fodder and grazing land.

There is a general agreement (75 percent) among the affected people in the area that now they are more prone to diseases as compared to the pre-project era. Earlier they suffered from the common diseases such as pox, measles, and fever, but now they suffer mainly from tuberculosis, malaria, respiratory problems and skin-eye irritation. The recent setting up of stone quarries in the area may however be partially responsible for some of the above illnesses. There has been no improvement in the medical facilities for the affected people since project implementation. The nearest government hospital in the area is in Robertsganj, about 40 km away. Hospital at the project colony caters only to the needs of the project employees and charges high fees from the outsiders. The

response varied on the issue of life expectancy and child mortality rate. About 60% of the respondents were of the opinion that there has been deterioration in these respects.

In the social front, the affected people in the area say that they feel more insecure, as many of their relatives and neighbours have left the village and settled elsewhere. In this situation, some of the people face problems of matrimonial alliances.

The food habits of the people have not changed. Their main food still consists of maize, barley, and til, with milk, vegetables and fruits supplementing their diets. However, since people now cultivate less fertile land, the productivity is much less. Thus people are no longer self sufficient, at depend on the market for partial fulfillment of their food requirements. They also say that the crops now produced are not as good in taste as it used to be in the pre-project era.

Before the project, every family had land to cultivate and this was their main occupation. But now nearly 50% of the family members, in each family, have to work as labourers to meet their daily requirements. There is no full time employment. About 90% of the people working as labourer complain that the contractor makes them sign for Rs 45/- but actually pays only Rs 25/-. In the absence of alternative form of employment this exploitation of the labour continues unabated.

5.6 People who were not Displaced, but Profoundly Affected

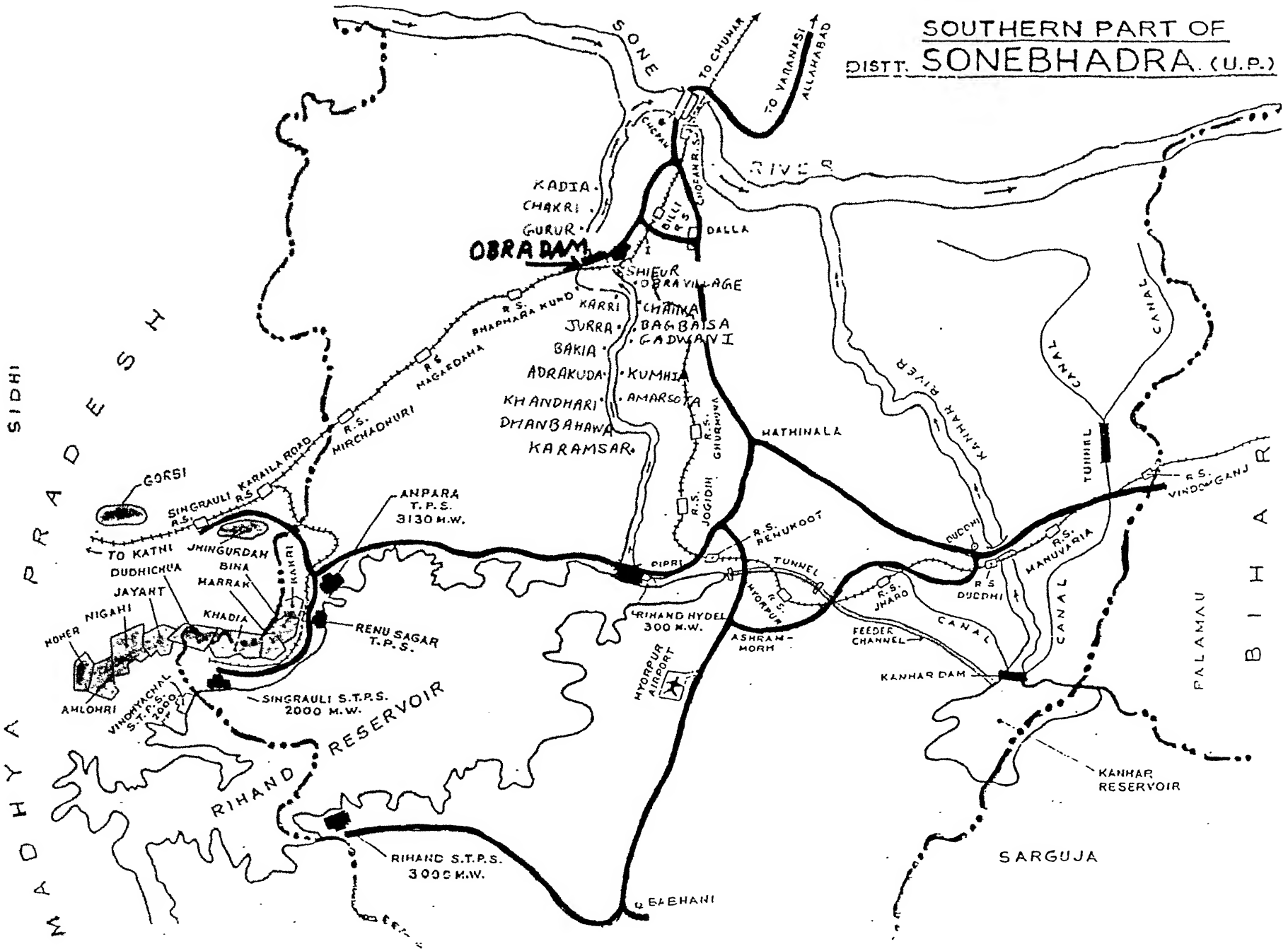
During the field study, people downstream of the dam were also contacted. These people have not lost their land due to project implementation. However, they have not gained much from the project. The fertility of the land they own decreased due to reduced flow of water in the river stretch downstream of the dam. Additionally, they have acted as hosts to people who were displaced by the dam. However, the relations among the hosts and the refugees are cordial. No social tension on the line of caste or insider/outsider status has been observed as expected in such cases of resettlements.

5.7 People Benefiting from Project Implementation

This category consists of people who are not in the immediate project area, but are the direct recipients of the benefits from the project. It also consists of the recent migrants, who have come due to increased availability of jobs due to project implementation. The lake created by dam construction is the source of drinking water for all and also the main source of water supply for the Obra thermal power plant. There are a lot of direct and indirect jobs created as a result of the industrialization in the area but they have mostly gone to the outside persons who have necessary expertise, skills and qualification. The locals have to remain content with the petty jobs such as that of daily labourer, watchmen, etc.

5.8 Conclusion

From this case study it can be probably stated that the benefits arising out of the project have not been actually enjoyed by those who have suffered the most due to project implementation. The affected people in the project area have lost not only their land, which is the main source of their livelihood, but also social security, health, access to common property resources and much more. Some people are of the opinion that, this is not the type of development, which is desirable on either economic or moral basis. When a particular section of a society reaps the benefits of a developmental project at the cost of another then such progress is against the concept of social equality, which is enshrined in our constitution.


SOUTHERN PART OF
DISTT. SONEBHADRA. (U.P.)
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TO CHUNAR
TO VARANASI
ALLAHABAD
RIVER
KADIA
CHAKRI
GURUR
OBRA DAM
DALLA
OBRA VILLAGE
CHAINA
BAGBAISA
GADWANI
KARRI
JURRA
BAKIA
ADRAKUDA
KUMHIA
AMARSOTA
KHANDHARI
DHANBAHAWA
KARAMSAR
R.S. PHAPHARA KUND
R.S. NAGEDHA
R.S. MIRCHADHURI
R.S. GHURMURA
R.S. JOGIDIH
MATHINALA
KANHAR RIVER
CANAL
TUNNEL
R.S. VINDHYANAGAR
MADHYA PRADESH
SIDHI
GORSI
SINGRAULI KARAILA ROAD
SINGRAULI R.S.
TO KATNI
JHINGURDAH
DUDHICHUA
BINA
JAYANT
NIGAHI
KHADIA
HARRAK
KHARI
KORER
AMLOHRI
ANPARA T.P.S. 3130 M.W.
RENU SAGAR T.P.S.
VINDHYACHAL S.T.P.S. 2000 M.W.
SINGRAULI S.T.P.S. 2000 M.W.
RIHAND RESERVOIR
RIHAND S.T.P.S. 3000 M.W.
R.S. RENUKOOT
PIPRI
TUNNEL
RIHAND HYDEL 300 M.W.
HYDRPUR
R.S.
HYDRPUR AIRPORT
ASHRAM-MORH
R.S. JHARO
FEEDER CHANNEL
CANAL
DUDHI
R.S. DUDHI
R.S. MANUVARIA
KANHAR DAM
KANHAR RESERVOIR
PALAMAU
BIHAR
SARGUJA
BAHANI

Fig. 5.1 Depleted State of Forest in the Obra Region

Fig. 5.2 Some of the Displaced Persons above 50 years

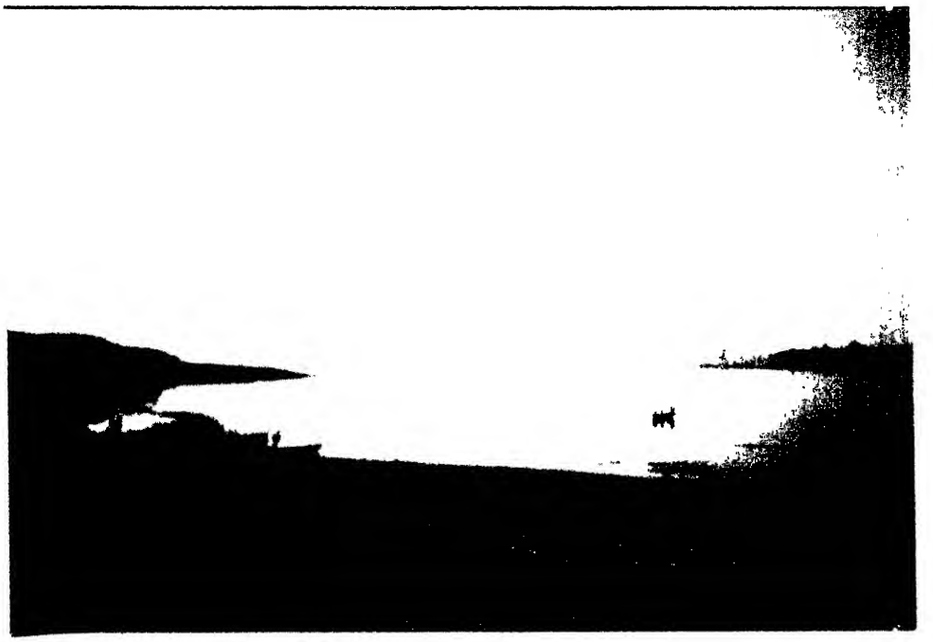

Fig. 5.3 The Only Mode Available for Crossing the Reservoir

Fig. 5.4 Thatched Houses of the Displaced Persons

Fig. 5.5 The State of Cattle in the Obra Region

Fig. 5.6 Some of the Project Affected Persons

CHAPTER 6

EVALUATION: ASSESSMENT OF IMPACT FACTORS AND ASSIGNMENT OF SIGNIFICANCE NUMBERS

6.1 Introduction

Evaluation of socio-economic impacts consists of two steps, assessment of impacts, and assignment of significance numbers to impacts. Since evaluation of socio-economic impacts is highly subjective, a lot of qualitative judgement is involved in assigning a significance value to a certain degree of impact. For example, based on the baseline and predicted impact study for a certain impact factor, one person may conclude the degree of impact is low, while based on the same study, someone else may consider the impact to be high. Thus the task of assessment of the degree of impact must be performed by a group of persons who have a through understanding of the project. Ideally, they must not be too closely involved with the project, so as to remove obvious bias. However, they must be given access to all related studies/reports regarding the socio-economic impacts of the project. A thorough perusal of these reports will enable them to form an opinion, and exercise informed judgement. The committee shall consist of experts from various fields, e.g., governmental agencies, politicians and decision-makers, experts in field of environmental evaluation, representatives from special interest groups, and members of the society in general. The committee should reach a consensus decision on evaluation of impacts. It is also possible to divide the impact factors into several sub-groups, and appoint different committees for assignment of different sets of impact factors.

6.2 Impact Factors and Guidelines for Studies to Determine Impact

Based on the background information presented in chapter 4, and the case study presented in chapter 5, an exhaustive list of parameters or impact factors relevant for SIA of large water resources projects has been identified. These factors are presented in a tabular form in Tables 6.1, 6.2 and 6.3. Impact factors presented in these tables may be considered to be the topics on which both baseline and predictive studies need to be performed. Guidelines for performing such studies are also incorporated in these tables. Once the relevant information regarding these parameters is available, the nature of the impact can be evaluated.

6.3 Procedure for Impact Assessment

Once the impact factors are identified and required studies for impact evaluation conducted, the next steps in the SIA process are the impact assessment and assignment of significance values to various impact factors.

The impacts can be assessed using the following guidelines. Impacts may be positive, negative or non-existent. Positive and negative impacts can be further evaluated with regard to their extent, magnitude and duration. In other words, the impacts may be either local/regional (LG), or regional/global (RG) in extent, high (H), medium (M) or low (L) in magnitude, and short term (ST) or long-term (LT) in duration. It can be assumed that the impacts in the construction phase of a project are short-term (ST), while those in the operation phase are long-term (LT). It is also assumed that the impact on category I, II, IIA, IIB, IIC and IIIA population are mainly local (LR) in extent, while those on category III population and regional/global (RG) in nature. In Tables 6.1, 6.2, and 6.3, the likely nature of various impacts have been suggested. It is implicit in these evaluations that the impacts in the construction phase are ST, while those in operation phase are LT. Also, the impacts on category I, category II, IIA, IIB, IIC and category IIIA population are LR, while those on category III population are RG.

It must be understood that the suggested nature of impacts mentioned in Tables 6.1, 6.2, and 6.3 cannot be taken as representative of any particular situation or project, and are presented for illustration purposes only. The exact nature of impact for each impact factor will vary from project to project, and can only be correctly evaluated and identified after conducting exhaustive baseline and predictive studies along the guidelines given in the same tables.

6.4 Incorporation of Mitigation Measures

As shown in Tables 6.1, 6.2 and 6.3, in some cases, the nature of impacts may change due to the incorporation of mitigation measures. In such cases, the likely mitigation

measures have also been mentioned, along with a suggestion for the likely change in the nature of impact if the mitigation measures are incorporated.

6.5 Assignment of Significance Values

Assignment of significance values involves transforming the qualitative impact assessments described in the previous section into numerical values for subsequent evaluations. The suggested scale for assignment of significance values is –100 to +100, with –100 signifying highly adverse impacts, +100 highly beneficial impacts, and 0 signifying non existent impacts. The actual assignment is done by taking into consideration the nature and magnitude (i.e., H, M, or L) of impact, i.e., by the assessment of impact factors. A suggested list of guidelines for assigning significance values based on the magnitude of impact is shown in Table 6.4

Table 6.4 Guidelines for Allotment of Significance Values

Magnitude of Impact	Adverse	Beneficial
High (H)	-70 to -100	+70 to +100
Medium (M)	-30 to -70	+30 to +70
Low (L)	0 to -30	0 to +30

These guidelines should not be dismissed as an indirect mechanism to reduce the freedom of the assessors' to assign significance values freely. Assigning significance values by following these guidelines will actually ensure that personal bias is eliminated to a great extent from the evaluation process.

Table 6.1 **Summary of Impact Factors, Likely Information Requirement for Determination of the Nature and Magnitude of Impacts, Likely Nature of Impacts, and Possible Mitigation Measures for a Socio—Economic Impact Assessment (SIA) Study for a Large Water Resources Development Project**

PEOPLE AFFECTED	PARAMETER	TYPE OF INFORMATION REQUIRED (BASELINE AND PREDICTION)	LIKELY NATURE AND MAGNITUDE OF THE IMPACT						MITIGATION MEASURES
			CONSTRUCTION PHASE			OPERATION PHASE			
			+ VE	- VE	NO	+ VE	- VE	NO	
CATEGORY I: PEOPLE DIRECTLY DISPLACED DUE TO SUBMERGENCE OF LAND	1. LAND SCENARIO	• Average legal land holding per family • Average encroached forest/waste/Govt. land per family • Average operational landholdings per family • Average land holdings per family which is fallow(unused) • Percentage of family land less • Percentage of family having operational land holding below 2 acres • Percentage of family having operational land holding below 5 acres & above 2 acres • Percentage of family having operational land holding below 10 acres & above 5 acres • Percentage of family having operational land holding above 10 acres •			[redacted]		Magnitude [redacted] Medium (M)		• Alternative land should be purchased, acquired, reclaimed, and allotted to the displaced people • Efforts should be made to allot cultivable land in the command area to the extent possible. • Formation of land purchase committee in this regard is necessary • Non Governmental Organizations (NGO) should be associated to assist the displaced people in the resettlement and rehabilitation process
CATEGORY I: PEOPLE DIRECTLY DISPLACED DUE TO SUBMERGENCE OF LAND	2. MARGINALIZATION	• Percentage of families who partially lost land • Percentage of families reduced to medium size farmers • Percentage of families reduced small size farmers • Percentage of families converted / reduced to small / petty buissness like, shopkeeping, etc. • Average operational land holding size per family			[redacted]		Magnitude [redacted]		• NGO assistance to be provided to the displaced people for identification of land and counselling for the purchase of land. • Agricultural land should be reclaimed and levelled before allotment to displaced people. • Land available near the rehabilitation site should be purchased, reclaimed and allotted to the displaced people to the extent possible. • All efforts should be made to ensure that the land allotted to displaced people are free from encroachment and all other encumbrances. • The land allotted to the displaced should be in one or two patches and not in small segments

Table 6.1 (Continued)

PEOPLE AFFECTED	PARAMETER	TYPE INFORMATION REQUIRED (BASELINE AND PREDICTION)	LIKELY NATURE AND MAGNITUDE OF THE IMPACT						MITIGATION MEASURES
			CONSTRUCTION PHASE			OPERATION PHASE			
			+VE	- VE	NO	+VE	-VE	NO	
CATEGORY I: PEOPLE DIRECTLY DISPLACED DUE TO SUBMERGENCE OF LAND	3. LOSS OF ACCESS TO COMMON PROPERTY	• Percentage of families having encroached forest/Govt. land • Average acres of encroached forest/Govt. land per family • Total area of land under shifting cultivation • Average area of land per family doing shifting cultivation • Accessibility to forest products • Percentage of families whose primary source of income is forest products • Percentage of families having access to grazing land • Percentage of families who have access to burial ground • Percentage of families having access to free use of water for drinking / irrigation							• Space for burial ground, grazing land to be earmarked for the • displaced in each relocation site. • Objectionable enchroached land should be settled in favour of the displaced persons • The displaced should be relocated in the similar eco zone to the extent possible.
CATEGORY I: PEOPLE DIRECTLY DISPLACED DUE TO SUBMERGENCE OF LAND	4. MORBIDITY	• Changes in Source of drinking water • Nature of the garbage disposal system • Changes in Toilet habits • Average distance of medical centers from the resettlement site • Frequency of visit of health workers to village / resettlement colony • Incidence of diseases due to changed geoclimatic conditions • Immunization status of infants, children & pregnant women • Mother Mortality Rate • Infant Mortality Rate • Life expectancy							• All the relocation sites should have tube wells to ensure safe drinking water. • There should be regular repairing and maintinance of the tube wells. • Space for garbage disposal should be earmarked • Each relocation site should be selected in a manner that is nearer to a health centre. • Health delivery system to be intensified in the relocated site for a period of one year from the time of physical displacement as this is considered the most vulnerable period fot the women and children in particular and for the entire population in general.

Table 6.1 (Continued)

PEOPLE AFFECTED	PARAMETER	TYPE INFORMATION REQUIRED (BASELINE AND PREDICTION)	LIKELY NATURE AND MAGNITUDE OF THE IMPACT						MITIGATION MEASURES
			CONSTRUCTION PHASE			OPERATION PHASE			
			+VE	- VE	NO	+VE	-VE	NO	
CATEGORY I: PEOPLE DIRECTLY DISPLACED DUE TO SUBMERGENCE OF LAND	5. SOCIAL DISLOCATION	• Changes in settlement pattern • Changes in social organization like caste / cultural / recreational / voluntary associations • Changes in political set up • Changes in marriage pattern / prospects • Disturbance in Kinship ties • Changes in inter family dependence and co-operation • Changes in type of family like combined / nuclear • Changes in community activities • Changes in labour exchange system / migration of labour							• The displaced of one village and one community should be resettled in one relocation site enblock. • Religious centers and cultural centers as existing in the predisplaced village to be relicated in the relocated site.
CATEGORY I: PEOPLE DIRECTLY DISPLACED DUE TO SUBMERGENCE OF LAND	6. AGRICULTURE AND FOOD	• Average crop yield per family per year • Principal source of food • Secondary source of food • Changes in principal diet • Changes in supplementary diet • Average surplus of food grains per family							• The land should be reclaimed and relevelled before handing over to the PAP's. • Waste land near the relocation site should be provided to the Displaced for mixed plantation and horticulture to supplement food requirement. • Agriculture extension farm training should be provided to the displaced on modern agricultural methods and allied choices like piggery, goatery, duckery etc. • High yield paddy seeds, farm equipments, pesticides and chemical fertilizers to be provided to the PAP's at subsidized rate. • Water harvesrting structures in the form of check dam should be built with the assistance of both the PAP's and the project so as to irrigate the land for increasing the crop intensity.

Table 6.1 (Continued)

PEOPLE AFFECTED	PARAMETER	TYPE INFORMATION REQUIRED (BASELINE AND PREDICTION)	LIKELY NATURE AND MAGNITUDE OF THE IMPACT						
			CONSTRUCTION PHASE			OPERATION PHASE			
			+VE	- VE	NO	+VE	-VE	NO	
CATEGORY I: PEOPLE DIRECTLY DISPLACED DUE TO SUBMERGENCE OF LAND	7. JOB SCENARIO	• Percentage of displaced people having their own land • Percentage of people cultivating their own land and also share croppers • Percentage of displaced people who are share croppers only • Share croppers & occasional wage earners • Percentage of farm wage earners • Percentage of service workers in agriculture sector • Percentage of service workers in non agricultural sector • Percentage of displaced without any gainful occupation • No. of days a month getting work • Percentage of families below poverty line			[redacted]		[redacted]		• Waste land near the relocation site should be allocated to the PAP's. • All the government work should be done in the area involving the displaced persons • All the displaced personsbelow the poverty line having no substantial source of livelihood should be economically rehabilitated by tieing up with the different existing poverty allevation and income generating schemes.
CATEGORY I: PEOPLE DIRECTLY DISPLACED DUE TO SUBMERGENCE OF LAND	8. HOME SCENARIO	• Percentage of families having their own houses • Percentage of families having concrete house roof • Percentage of families tiled/asbestos roofed house • Percentage of families having thatched roof • Percentage of families staying in relatives/fathers/rented house • Percentage of families having one room accommodation • Percentage of families having two room accommodation • Percentage of families having three room accommodation • Percentage of families having four room accommodation • Average number of persons per living room			[redacted]		[redacted]		• The displaced persons below the poverty line should be provided with house. • NGO's should be associated in the project to motivate the PAP's and to do the counselling so as to construct the house. • The house construction allowance should be released in a passed manner looking at the progress of the house construction.

Table 6.1 (Continued)

PEOPLE AFFECTED	PARAMETER	TYPE INFORMATION REQUIRED (BASELINE AND PREDICTION)	LIKELY NATURE AND MAGNITUDE OF THE IMPACT						MITIGATION MEASURES
			CONSTRUCTION PHASE			OPERATION PHASE			
			+VE	-VE	NO	+VE	-VE	NO	
CATEGORY I: PEOPLE DIRECTLY DISPLACED DUE TO SUBMERGENCE OF LAND	1. DIRECT ECONOMIC DEVELOPMENT	• Number of people getting direct job in the project • Number of people working in the public facilities created • Number of people working in the domestic sector • Number of people working as daily wage labourer		[redacted]		[redacted]			• The displaced persons should be given preference in all the jobs generating from the project
	2. INDIRECT ECONOMIC DEVELOPMENT	• Percentage increase in employment generated by ancillary industries • Percentage increase in employment created in maintenance, servicing and repairing sector • Percentage increase in non farm products like animal husbandry, fisheries, etc •		[redacted]		[redacted]			• The displaced persons should be imparted vocational training to set up small industries • Low interest loans should be provided to them
	3. EDUCATION	• Number of Primary Schools • Number of Vocational/Technical Institutions • Number of Secondary Schools • Student/Teacher Ratio		[redacted]		[redacted]			• The wards of the displaced persons should be given preference in admission • Monetary assistance should be provided to them
	4. MEDICAL FACILITIES	• Doctor/Patient Ratio • Number of Community Health Workers • Number of Medical Stores • Number of Clinics/Hospitals • Number of Ambulance/Associated Equipment		[redacted]		[redacted]			• The displaced persons should be given preference in the medical treatment
	5. TRANSPORTATION	• Number of bicycles • Number of Mopeds/Scooters/Motorcycles • Number of Cars/Trucks/Taxis • Distance to Bus/Railway Station • Road/Railway Density • Number of Road side Dhabas, Service Stations		[redacted]		[redacted]			

Table 6.1 (Continued)

PEOPLE AFFECTED	PARAMETER	TYPE INFORMATION REQUIRED (BASELINE AND PREDICTION)	LIKELY NATURE AND MAGNITUDE OF THE IMPACT						MITIGATION MEASURES
			CONSTRUCTION PHASE			OPERATION PHASE			
			+VE	-VE	NO	+VE	-VE	NO	
CATEGORY I: PEOPLE DIRECTLY DISPLACED DUE TO SUBMERGENCE OF LAND	6. ENTERTAINMENT AND MASS MEDIA EXPOSURE	• Number of Radio sets • Number of TV sets • Number of Cinema Halls • Number of Video Parlours • Number of Sports Ground/Parks • Number and types of news papers in circulation		[redacted]		[redacted]			• TV / Radio set should be installed at the community center • Educational and informative films should be screened from time to time without any charge
	7. PUBLIC SAFETY	• Number of Police Stations • Number of Fire Fighting Stations		[redacted]		[redacted]			•
	8. SANITATION	• Number of Public Lavatories • Number of Water closet • Number of Soak Pits • Number of people availing these facilities •		[redacted]		[redacted]			• People should be taught the advantage of using the new sanitation facilities
	9. PUBLIC UTILITIES	• Number of people having access to Electricity • Number of people having access to Natural Gas/Petroleum Products • Number of people having access to good quality water • Number of people having access to Essential Commodities • Number of people having access to Communication/Postal Services • Number of Banks / Insurance companies in operation		[redacted]		[redacted]			• All the public utilities should be made available to the displaced persons at reasonable cost
	10. GOVERNMENT ADMINISTRATION	• Number of Government Offices • Number of Courts		[redacted]		[redacted]			•

Table 6.2 Category II, IIA, IIB, and IIC: **Summary of Impact Factors, Likely Information Requirement for Determination of the Nature and Magnitude of Impacts, Likely Nature of Impacts, and Possible Mitigation Measures for a Socio—Economic Impact Assessment (SIA) Study for a Large Water Resources Development Project**

AFFECTED POPULATION	PARAMETER	TYPE OF INFORMATION REQUIRED (BASELINE AND PREDICTION)	LIKELY NATURE AND MAGNITUDE OF THE IMPACT						MITIGATION MEASURES
			CONSTRUCTION PHASE			OPERATION PHASE			
			+VE	-VE	NO	+VE	-VE	NO	
CATEGORY II: PEOPLE WHO ARE NOT DIRECTLY DISPLACED, BUT SUBSTANTIALLY AFFECTED	1. AGRICULTURE AND CROPPING PATTERN	• Changes in the soil fertility • Changes in the crop yields • Changes in cropping pattern • Percentage increase in the use of artificial fertilizers. • Percentage increase in the use of pesticides • Percentage increase in the use of herbicides • Percentage change in high yielding variety (HYV) crop production • Percentage change in production of water intensive cropping • Percentage change in mono cropping • Percentage change in the area affected by water logging and salinity			[redacted]	[redacted]			• Farmers should be taught about the importance of crop rotation. • There should be equitable distribution of water. • Tendency of mono cropping should be discouraged • Farmers must be given knowledge of the ill effects of the use of agro • Lining of canals and watercourses. • Reduction in the intensity of irrigation. • By introducing crop rotation. • Optimum use of water • Providing intercepting drains. • Providing an efficient drainage system. • Improving the natural drainage of the area. • Introduction of lift irrigation. • Peasants should be taught about the optimum use of water • When water is not required for irrigation, there should be no water in the canals.
CATEGORY II: PEOPLE WHO ARE NOT DIRECTLY DISPLACED, BUT SUBSTANTIALLY AFFECTED	2. TRANSMISSION LINES	• Amount of Agricultural/Forest land lost in Right of Way • Health effects due to strong Electric and Magnetic Fields • Increase in distortion to Communicational Signals • Health effects due to formation of Ozone			[redacted]		[redacted]		• A broad-based 400kv double circuit tower occupies a land area of about 100sqmt where as a narrow based tower occupies 95sqmt. Hence narrow based design should be adopted. • Underground transmission cables can be laid. • People should be taught not to spent much of their time below the transmission lines and also not allow their cattle's to come in contact of electrical and magnetic fields of these transmission lines as studies have shown that cows which comes under the influence of these fields for long time give less milk.

Table 6.2 Continued

AFFECTED POPULATION	PARAMETER	TYPE OF INFORMATION REQUIRED (BASELINE AND PREDICTION)	LIKELY NATURE AND MAGNITUDE OF THE IMPACT						MITIGATION MEASURES
			CONSTRUCTION PHASE			OPERATION PHASE			
			+VE	-VE	NO	+VE	-VE	NO	
CATEGORY II: PEOPLE WHO ARE NOT DIRECTLY DISPLACED, BUT SUBSTANTIALLY AFFECTED	3. HEALTH ASPECTS	• Percentage change in the malaria cases. • Percentage change in the filaria cases • Percentage changes in numbers of other important diseases • Changes in number of health centers / dispensaries, medical shops, doctor / patient ratio. • Changes in life expectancy. • Average number of healthy working days per person • Health hazard due to contamination of groundwater. • Health hazard due to contamination of surface water • Health hazard due to increased use of agro-chemicals, and other industrial chemicals.			[redacted]		[redacted]		• People need to be taught about the disease vector habitat, transmission route and necessary steps should be taken to destroy them. • Ground water contamination should be avoided by proper disposal of domestic and industrial waste. • The irrigation system consisting of branches, minors and sub minors should be properly graded, maintained and cleaned of weeds to prevent vector breeding. • Labour movement from endemic areas to non-endemic areas may disseminate infection of parasitic diseases. It is there fore necessary that itinerant labour is well protected by administering radical treatment on arrival and departure.
CATEGORY II: PEOPLE WHO ARE NOT DIRECTLY DISPLACED, BUT SUBSTANTIALLY AFFECTED	4. GOVERNMENT ADMINISTRATION	• Number of Government Offices • Number of Courts			[redacted]	[redacted]			

Table 6.2 Continued

PEOPLE AFFECTED	PARAMETER	TYPE OF INFORMATION REQUIRED (BASELINE AND PREDICTION)	LIKELY NATURE AND MAGNITUDE OF THE IMPACT						MITIGATION MEASURES
			CONSTRUCTION PHASE			OPERATION PHASE			
			+VE	-VE	NO	+VE	-VE	NO	
CATEGORY II: PEOPLE WHO ARE NOT DIRECTLY DISPLACED, BUT SUBSTANTIALLY AFFECTED	5. DIRECT ECONOMIC DEVELOPMENT	• Percentage of people getting direct job in the project • Changes in per capita income of the people • Percentage of people working in the public facilities created • Percentage of people working in the domestic sector • Percentage of people working as daily wage labourer	[redacted]			[redacted]			• People of the area should be given more of vocational and technical training • Government preferences to be given to local people for employment in the project
	6. INDIRECT ECONOMIC DEVELOPMENT	• Percentage increase in the employment in tertiary industries • Percentage increase in employment generated the ancillary industries • Percentage increase in employment created in maintenance, servicing and repairing sector • Percentage increase in non farm products like animal husbandry, fisheries, etc • Percentage increase in preference for consumer durables •	[redacted]			[redacted]			
	7. EDUCATION	• Number of Primary / Secondary Schools • Number of Colleges • Number of Vocational/Technical Institutions • Student/Teacher Ratio			[redacted]	[redacted]			• New schools opening in the project area should be accessible to local population
	8. MEDICAL FACILITIES	• Doctor/Patient Ratio • Number of Community Health Workers • Number of Medical Stores • Number of Clinics/Hospitals • Number of Ambulance/Associated Equipment			[redacted]	[redacted]			• New medical facilities and hospitals opening in the project area should be affordable and accessible to local population
	9. TRANSPORTATION	• Number of Bicycles • Number of Mopeds/Scooters/Motorcycles • Number of Cars/Trucks/Taxis • Distance to Bus/Railway Station • Road/Railway Density • Number of Road side Hotels, Service Stations			[redacted]	[redacted]			

Table 6.2 Continued

PEOPLE AFFECTED	PARAMETER	TYPE OF INFORMATION REQUIRED (BASELINE AND PREDICTION)	LIKELY NATURE AND MAGNITUDE OF THE IMPACT						MITIGATION MEASURES
			CONSTRUCTION PHASE			OPERATION PHASE			
			+VE	-VE	NO	+V	-VE	NO	
CATEGORY II: PEOPLE WHO ARE NOT DIRECTLY DISPLACED, BUT SUBSTANTIALLY AFFECTED	1. ENTERTAINMENT AND MASS MEDIA EXPOSURE	• Number of Radio sets • Number of TV sets • Number of Cinema Halls • Number of Video Parlours • Number of Sports Ground/Parks • Number and type of News Paper in circulation			[redacted]	[redacted]			
	2. PUBLIC SAFETY / SECURITY	• Number of Police Stations • Number of Fire Fighting Stations			[redacted]	[redacted]			• Crime is likely to increase in the project area. Suitable crime prevention measures must be taken
	3. SANITATION	• Number of Public Lavatories • Number of Water closet • Number of Soak Pits • Number of people availing these facilities •			[redacted]	[redacted]			• Sanitation facilities must be made available to the local population
	4. PUBLIC UTILITIES	• Number of people having access to Electricity • Number of people having access to Natural Gas/Petroleum Products • Number of people having access to Good Quality water • Number of people having access to Public Distribution System • Number of people having access to Communication/Postal Services • Number of Banks / Insurance companies in operation			[redacted]	[redacted]			• Public utilities must be accessible to local population
	5. TOURISM AND RECREATIONAL OPPORTUNITIES	• Perceived changes in aesthetic value • Percentage increase in the inflow of tourist • Percentage increase in the employment opportunities generated at the reservoir site			[redacted]	[redacted]			• Due attention needs to be paid to develop this sector by the government
	6. NAVIGATION	• Percentage reduction in Transportation cost • Percentage reduction in Congestion on Roads/Railway Systems			[redacted]	[redacted]			

Table 6.2 Continued

PEOPLE AFFECTED	PARAMETER	TYPE OF INFORMATION REQUIRED (BASELINE AND PREDICTION)	LIKELY NATURE AND MAGNITUDE OF THE IMPACT						MITIGATION MEASURES
			CONSTRUCTION PHASE			OPERATION PHASE			
			+VE	-VE	NO	+VE	-VE	NO	
CATEGORY II: A (SPECIAL CASE) 1. EXISTING POPULATION IN RESETTLEMENT AREA	1. GENERAL LIVING STANDARD AND QUALITY OF LIFE	• Percentage change in employment opportunities due to resettlement of the displaced people in the area • Change in the use pattern of encroached land/burial grounds • Changes in access to common property resources • Changes in access to public utilities • Increase in social tensions due to resettlement and rehabilitation of the displaced people. • Jealousy and discontent due to assistance being offered to the displaced people. • Problems arising out of cultural and religious adjustment							• Infrastructure and support facilities at the relocation site must be shared with the existing community • Efforts should be made to rope in the host population during the formation of R& R package. • The existing community must be given access to training, employment and other benefits generated from the project. • Those in the existing community who lose land, house, shop or any other means of employment as a result of resettlement must be given the same compensation package as enjoyed by the displaced persons.
CATEGORY II: B (SPECIAL CASE) 2. PEOPLE IN NON-SUBMERGING HAMLETS AROUND RESERVOIR RIM	1. GENERAL LIVING STANDARD AND QUALITY OF LIFE	• Changes in employment opportunities. • Average distance of public facilities • Occurrence of new diseases • Psychological/mental state due to feeling of left alone • Adaptation to changes in climate. • Monetary aspects involved with the changes in the mode of transport. • Effect on the local business in the area							• The people of the non-submerging hamlets should be given the option to come under the category of displaced persons and avail the R & R package. • Detailed studies should be done about the changes in climate, eruption of new diseases, changes in employment, job pattern, etc. after submergence and adequate measures must be taken to reduce the adverse effect if any. • Good communicational facilities must be made available at cheap prices. • More of public utility facilities should be opened in the area. • A resettlement officer should be placed in the area to bring the problems faced by the general public. Help of NGO in this regard can also be taken.

Table 6.2 Continued

AFFECTED POPULATION	PARAMETER	TYPE OF INFORMATION REQUIRED (BASELINE AND PREDICTION)	LIKELY NATURE AND MAGNITUDE OF THE IMPACT						MITIGATION MEASURES
			CONSTRUCTION PHASE			OPERATION PHASE			
			+VE	-VE	NO	+VE	-VE	NO	
CATEGORY IIC: (SPECIAL CASE) 3. PEOPLE DOWNSTREAM OF THE DAM	1. AGRICULTURE	• Changes in the soil fertility • Changes in the crop yields • Changes in cropping pattern • Changes in area available for agriculture							• Use of organic manure should be promoted. • Physical transportation of nutrient rich soil from the upstream area to down stream can be an option, but it's economic feasibility has to be explored. • Farmers should be taught about the long term effects of using agro chemicals on soil fertility, accumulation in food chain, and resistance of pests towards it. • Practice of mono cropping should be discouraged.
3. PEOPLE DOWNSTREAM OF THE DAM	2. FISHERY	• Percentage change in fish catch • Change in fish species diversity • Change in the quality of fish catch • Change in income of those related to fishing industry							• A fish ladder should be provided wherever possible to enable the fish to pass the barrier. • In dams the fish also needs to be protected from turbines and spillways. If the head is less than 5m or so, the fish can pass through turbines and spillways with very low mortality. But this is not possible in large dams where large head is needed for power generation. • Appropriate management of spillways and power station during the periods when fish stay in this sector can resolve the problem of gas bubble disease. Another measure is to reduce the gradient of the spillway.

Table 6.2 Continued

AFFECTED POPULATION	PARAMETER	TYPE OF INFORMATION REQUIRED (BASELINE AND PREDICTION)	LIKELY NATURE AND MAGNITUDE OF THE IMPACT						MITIGATION MEASURES
			CONSTRUCTION PHASE			OPERATION PHASE			
			+VE	-VE	NO	+VE	-VE	NO	
CATEGORY IIC: (SPECIAL CASE) PEOPLE DOWNSTREAM OF THE DAM	3. WATER AVAILABILITY AND QUALITY	• Hindrance to navigation • Changes in the availability of water • Changes in the surface water quality • Changes in the ground water quality • Changes in ground water pumping rates • Chances of saline water ingress • Chances of ground water subsidence • Changes in number of open wells, dug wells, tube wells, hand pumps, etc. • Change in cost of treatment of water for domestic and industrial use • Change in access to canal irrigation facilities			[redacted]		[redacted]		• An effective national policy needs to be framed and implemented to ensure proper water management. • There is an urgent need to solve the inter state disputes related to water storage and distribution. • Stringent laws needs to be passed and enforced against the dumping of untreated industrial and domestic effluent in rivers and their tributaries. • Stringent laws needs to be passed and enforced against over exploitation of ground water especially in coastal areas to check saltwater ingress. Alternate water supply arrangements must be made for those on down stream to overcome the shortage caused due to reduction in stream flow
	4. DAM FAILURE / SABOTAGE	• Probable seismic shocks in the project area			[redacted]		[redacted]		• Thorough geological survey of the area needs to be done before the construction of the project. • To build confidence among the locals and those on the down stream, they should be informed about the safety measures taken in the dam construction. • Efficient detection measures should be installed to report any case of dam breaches, tremors etc. and immediate remedial measures should be taken. • Efforts should to taken to reduce reservoir sedimentation.
	5. FLOOD CONTROL	• Changes in the flood frequency and severity			[redacted]	[redacted]			• Water releases from the dam must be controlled • Enough warning must be given bwfore water release
	6. LAND RECLAMATION	• Percentage change in the land available downstream of the dam			[redacted]	[redacted]			• Water must be so released from the dam that it does not damage the crops downstream • Advance warning must be given before actually releasing the water

Table 6.3 Category III and IIIA: **Summary of Impact Factors, Likely Information Requirement for Determination of the Nature and Magnitude of Impacts, Likely Nature of Imp. and Possible Mitigation Measures for a Socio—Economic Impact Assessment (SIA) Study for a Large Water Resources Development Project**

AFFECTED POPULATION	PARAMETER	TYPE OF INFORMATION REQUIRED (BASELINE AND PREDICTION)	LIKELY NATURE AND MAGNITUDE OF THE IMPACT						MITIGATION MEASURES
			CONSTRUCTION PHASE			OPERATION PHASE			
			+VE	-VE	NO	+VE	-VE	NO	
CATEGORY III: REGIONAL POPULATION, BEING AFFECTED BY THE PROJECT	1. NAVIGATION	• Percentage reduction in transportation cost • Percentage reduction in congestion on Roads / Railway systems			[redacted]	[redacted]			• People should be encouraged to take up water as a source of transportation. • Necessary infrastructure facilities should be provided by the government
	2. DRINKING WATER SUPPLY	• Percentage increase in the volume of safe drinking water to cities • Percentage reduction in population dependent on ground water resource • Reduction in the time spent to collect water • Percentage reduction in water transmitted diseases			[redacted]	[redacted]			• Both urban and rural water supply schemes are implemented for supply od water to the regional population
	3. INDUSTRIAL WATER SUPPLY	• Percentage increase in the industries heavily dependent on water			[redacted]	[redacted]			

Table 6.3 (Continued)

AFFECTED POPULATION	PARAMETER	TYPE INFORMATION REQUIRED (BASELINE AND PREDICTION)	LIKELY NATURE AND MAGNITUDE OF THE IMPACT						MITIGATION MEASURES
			CONSTRUCTION PHASE			OPERATION PHASE			
			+VE	-VE	NO	+VE	-VE	NO	
CATEGORY III: REGIONAL POPULATION, BEING AFFECTED BY THE PROJECT	4. IRRIGATION WATER SUPPLY	• Percentage increase in crop yields • Reduction / Elimination of mixed cropping patterns							
	5. HYDRO-ELECTRIC POWER	• Percentage increase in hydro power generation • Reduction in pollution due to reduction in use of non renewable fuel • Percentage increase in the consequent growth of industry • Percentage increase in supply of power to the electrical grid.							
	6. INDIRECT ECONOMIC DEVELOPMENT	• Percentage increase in the ancillary industries • Percentage increase in the tertiary sector • Percentage increase in employment generated by industrial sector. • Percentage increase in employment created in maintenance, servicing and repairing sector							• Proper economic policies adopted to attract industries to the area • Provision of incentives like tax holiday, sites, reduction in bureaucratic interference, etc. • Maintenance of stong and effective political, civil and police administration
	7. WATER LOGGING AND SALINITY	• Area of formerly arid land that will come under irrigation • Soil survey of the ;and in command area to determine the permeability and other soil characteristics related to water logging • Analysis of the expected reservoir water with regard to soil content							• Lining of canals and water courses. • Reduction in the intensity of irrigation. • By introducing crop rotation. • Optimum use of water. • Providing intercepting drains. • Providing an efficient drainage system. • Improving the natural drainage of the area. • Introduction of lift irrigation.
	8. WATER RIGHTS DISPUTE	• Increase in inter-regional/inter-state conflicts over sharing of water							• There should be proper aggrement for sharing the water before the commencement of the project • In case of some dispute arising afterward the decision of some apex body should be made final

Table 6.3 (Continued)

AFFECTED POPULATION	PARAMETER	TYPE INFORMATION REQUIRED (BASELINE AND PREDICTION)	LIKELY NATURE AND MAGNITUDE OF THE IMPACT						MITIGATION MEASURES
			CONSTRUCTION PHASE			OPERATION PHASE			
			+VE	-VE	NO	+VE	-VE	NO	
CATEGORY IIIA: RECENT MIGRANTS TO THE PROJECT AREA	1. DIRECT ECONOMIC DEVELOPMENT	• Percentage of people getting direct job in the project • Changes in the per capita income of the people • Percentage of category IIIA people getting direct jobs in the project							
	2. INDIRECT ECONOMIC DEVELOPMENT	• Percentage increase in employment created in ancillary industries • Percentage increase in employment created in maintenance, servicing and repairing sector • Percentage of category IIIA people in these occupations							
	3. EDUCATION	• Increases in the number of schools, colleges etc. due to project implementation • Number of people working as teachers/other activities related to education • Ratio of the category IIIA children to the other categories of children studying							
	4. MEDICAL FACILITIES	• Number of people working as doctors/nurses/compounders and other activities related to health services • Ratio of the number of category III persons to the other categories of persons availing such facility							
	5. TRANSPORTATION	• Percentage increase in number of bicycles • Percentage increase in the number of mopeds/scooters/motorcycles • Percentage increase in number of car/taxi/truck • Improvements to the road / railway network							

AFFECTED POPULATION	PARAMETER	TYPE INFORMATION REQUIRED (BASELINE AND PREDICTION)	LIKELY NATURE AND MAGNITUDE OF THE IMPACT						MITIGATION MEASURES
			CONSTRUCTION PHASE			OPERATION PHASE			
			+VE	-VE	NO	+VE	-VE	NO	
	6. ENTERTAINMENT AND MASS MEDIA EXPOSURE	• Number of radio/TV sets • Number of people visiting cinema halls/video parlours • Number of people having access to newspapers/other informative material	M			M			
	7. PUBLIC SAFETY/ SECURITY	• Number of police/fire fighting personals per 1000 population	M			M			
	8. PUBLIC UTILITIES	• Number of people having access to bank/insurance companies • Number of people having access to electricity/petroleum products/natural gas	M			M			
	9. SANITATION	• Percentages of residences occupied by category IIIA people which are connected to the sewer system		M		M			

CHAPTER 7

DECISION MAKING: PROJECT IMPLEMENTATION BASED SOCIO-ECONOMIC IMPACT ASSESSMENT

7.1 Introduction

The procedure for impact evaluation, i.e., impact assessment, and assignment of significance numbers to impact factors were discussed in chapter 6. The significance number in this case is a measure of the extent of impact, either beneficial, or adverse, on individual impact factors. However, mere assignment of significance numbers is not sufficient for determination of the project impact on the socio-economic environment. A procedure is required for the synthesis of these individual significance numbers into a composite score, which will signify the acceptability or otherwise of a project from the socio-economic perspective. In this context, it must be understood that all impacted parameters or impact factors are not equally critical from the SIA perspective. For example, a certain impact factor may have been assigned an exceptionally high adverse significance number. This would only have a significant impact on the acceptability of the project, if and only if the impact factor is considered to be important, i.e., it is assigned a high weightage.

Calculation of a composite score or index should take into account not only the extent of the impact (as represented by the significance number), but also the importance of a particular impact factor in a larger scheme of things. This would require assignment of weightages to individual impact factors. The procedure for assigning such impact factors is described in the next section. Tables 7.1, 7.2, 7.3, 7.4, 7.5, and 7.6, further illustrates the above points.

7.2 Assignment of Weightage to Various Impact Factors

The suggested method for assigning weights to various impact factors is the ranked pair-wise comparison technique (RPCT). In this method, one first arranges the impact factors in a particular list (e.g, Tables 7.1, 7.2, 7.3, 7.4, 7.5, and 7.6) in their order of relative importance. For example, consider Table 7.6; In this table, there are seven distinct groups of people, i.e., parameters that are affected by implementation of large water

Table 7.1 Weightages and Significance Factors for Category I Population

PEOPLE AFFECTED	IMPACT FACTOR OR PARAMETER	CONSTRUCTION PHASE		OPERATION PHASE	
		Weightage	Significance	Weightage	Significance
CATEGORY I: PEOPLE DIRECTLY DISPLACED DUE TO SUBMERGENCE OF LAND	1. LANDLESSNESS	$^{1}w_{c}^{1}$	$^{1}S_{c}^{1}$	$^{1}w_{OP}^{1}$	$^{1}S_{OP}^{1}$
	2. MARGINALIZATION	$^{1}w_{c}^{2}$	$^{1}S_{c}^{2}$	$^{1}w_{OP}^{2}$	$^{1}S_{OP}^{2}$
	3. LOSS OF ACCESS TO COMMON PROPERTY	$^{1}w_{c}^{3}$	$^{1}S_{c}^{3}$	$^{1}w_{OP}^{3}$	$^{1}S_{OP}^{3}$
	4. INCREASED MORBIDITY	$^{1}w_{c}^{4}$	$^{1}S_{c}^{4}$	$^{1}w_{OP}^{4}$	$^{1}S_{OP}^{4}$
	5. SOCIAL DISARTICULATION	$^{1}w_{c}^{5}$	$^{1}S_{c}^{5}$	$^{1}w_{OP}^{5}$	$^{1}S_{OP}^{5}$
	6. FOOD INSECURITY	$^{1}w_{c}^{6}$	$^{1}S_{c}^{6}$	$^{1}w_{OP}^{6}$	$^{1}S_{OP}^{6}$
	7. JOBLESSNESS	$^{1}w_{c}^{7}$	$^{1}S_{c}^{7}$	$^{1}w_{OP}^{7}$	$^{1}S_{OP}^{7}$
	8. HOME LESSNESS	$^{1}w_{c}^{8}$	$^{1}S_{c}^{8}$	$^{1}w_{OP}^{8}$	$^{1}S_{OP}^{8}$
	9. DIRECT ECONOMIC DEVELOPMENT	$^{1}w_{c}^{9}$	$^{1}S_{c}^{9}$	$^{1}w_{OP}^{9}$	$^{1}S_{OP}^{9}$
	10. INDIRECT ECONOMIC DEVELOPMENT	$^{1}w_{c}^{10}$	$^{1}S_{c}^{10}$	$^{1}w_{OP}^{10}$	$^{1}S_{OP}^{10}$
	11. EDUCATION	$^{1}w_{c}^{11}$	$^{1}S_{c}^{11}$	$^{1}w_{OP}^{11}$	$^{1}S_{OP}^{11}$
	12. MEDICAL FACILITIES	$^{1}w_{c}^{12}$	$^{1}S_{c}^{12}$	$^{1}w_{OP}^{12}$	$^{1}S_{OP}^{12}$
	13. TRANSPORTATION	$^{1}w_{c}^{13}$	$^{1}S_{c}^{13}$	$^{1}w_{OP}^{13}$	$^{1}S_{OP}^{13}$
	14. ENTERTAINMENT	$^{1}w_{c}^{14}$	$^{1}S_{c}^{14}$	$^{1}w_{OP}^{14}$	$^{1}S_{OP}^{14}$
	15. PUBLIC SAFETY	$^{1}w_{c}^{15}$	$^{1}S_{c}^{15}$	$^{1}w_{OP}^{15}$	$^{1}S_{OP}^{15}$
	16. SANITATION	$^{1}w_{c}^{16}$	$^{1}S_{c}^{16}$	$^{1}w_{OP}^{16}$	$^{1}S_{OP}^{16}$
	17. PUBLIC UTILITIES	$^{1}w^{17}$	$^{1}S_{c}^{17}$	$^{1}w_{OP}^{17}$	$^{1}S_{OP}^{17}$
	18. GOVERNMENT ADMINISTRATION	$^{1}w_{c}^{18}$	$^{1}S_{c}^{18}$	$^{1}w_{OP}^{18}$	$^{1}S_{OP}^{18}$

Composite significance value for category II: $(^{I}S_{c}) = \sum_{i=1,18} {}^{1}S_{c}^{i} . {}^{1}w_{c}^{i}$, and $(^{I}S_{OP}) = \sum_{i=1,18} {}^{1}S_{OP}^{i} . {}^{1}w_{OP}^{i}$

Table 7.2 Weightages and Significance Factors for Category II Population

PEOPLE AFFECTED	IMPACT FACTOR OR PARAMETER	CONSTRUCTION PHASE		OPERATION PHASE	
		Weightage	Significance	Weightage	Significance
CATEGORY II: PEOPLE WHO ARE NOT DIRECTLY DISPLACED, BUT SUBSTANTIALLY AFFECTED	1. AGRICULTURE AND CROPPING PATTERN	$^{2}w_{c}^{1}$	$^{2}S_{c}^{1}$	$^{2}w_{OP}^{1}$	$^{2}S_{OP}^{1}$
	2. HEALTH ASPECTS	$^{2}w_{c}^{2}$	$^{2}S_{c}^{2}$	$^{2}w_{OP}^{2}$	$^{2}S_{OP}^{2}$
	3. TRANSMISSION LINES	$^{2}w_{c}^{3}$	$^{2}S_{c}^{3}$	$^{2}w_{OP}^{3}$	$^{2}S_{OP}^{3}$
	4. DIRECT ECONOMIC DEVELOPMENT	$^{2}w_{c}^{4}$	$^{2}S_{c}^{4}$	$^{2}w_{OP}^{4}$	$^{2}S_{OP}^{4}$
	5. INDIRECT ECONOMIC DEVELOPMENT	$^{2}w_{c}^{5}$	$^{2}S_{c}^{5}$	$^{2}w_{OP}^{5}$	$^{2}S_{OP}^{5}$
	6. EDUCATION	$^{2}w_{c}^{6}$	$^{2}S_{c}^{6}$	$^{2}w_{OP}^{6}$	$^{2}S_{OP}^{6}$
	7. MEDICAL FACILITIES	$^{2}w_{c}^{7}$	$^{2}S_{c}^{7}$	$^{2}w_{OP}^{7}$	$^{1}S_{OP}^{7}$
	8. TRANSPORTATION	$^{2}w_{c}^{8}$	$^{2}S_{c}^{8}$	$^{2}w_{OP}^{8}$	$^{2}S_{OP}^{8}$
	9. ENTERTAINMENT	$^{2}w_{c}^{9}$	$^{2}S_{c}^{9}$	$^{2}w_{OP}^{9}$	$^{2}S_{OP}^{9}$
	10. PUBLIC SAFETY	$^{2}w_{c}^{10}$	$^{2}S_{c}^{10}$	$^{2}w_{OP}^{10}$	$^{2}S_{OP}^{10}$
	11. SANITATION	$^{2}w_{c}^{11}$	$^{2}S_{c}^{11}$	$^{2}w_{OP}^{11}$	$^{2}S_{OP}^{11}$
	12. PUBLIC UTILITIES	$^{2}w_{c}^{12}$	$^{2}S_{c}^{12}$	$^{2}w_{OP}^{12}$	$^{2}S_{OP}^{12}$
	13. GOVERNMENT ADMINISTRATION	$^{2}w_{c}^{13}$	$^{2}S_{c}^{13}$	$^{2}w_{OP}^{13}$	$^{2}S_{OP}^{13}$
	14. TOURISM AND RECREATIONAL OPPORTUNITIES	$^{2}w_{c}^{14}$	$^{2}S_{c}^{14}$	$^{2}w_{OP}^{14}$	$^{2}S_{OP}^{14}$
	15. NAVIGATION	$^{2}w_{c}^{15}$	$^{2}S_{c}^{15}$	$^{2}w_{OP}^{15}$	$^{2}S_{OP}^{15}$

Composite significance value for category II: $(^{II}S_c) = \sum_{i=1,15} {}^{2}S_c^i . {}^{2}W_c^i$, and $(^{II}S_{OP}) = \sum_{i=1,15} {}^{2}S_{OP}^i . {}^{2}W_{OP}^i$

Table 7.3 Weightages and Significance Factors for Category IIA, IIB, and IIC Population

PEOPLE AFFECTED	IMPACT FACTOR OR PARAMETER	CONSTRUCTION PHASE		OPERATION PHASE	
		Weightage	Significance	Weightage	Significance
CATEGORY IIA: EXISTING POPULATION IN RESETTLEMENT AREA	1. GENERAL LIVING STANDARD AND QUALITY OF LIFE	$^{2A}w_c^1$	$^{2A}S_c^1$	$^{2A}S_{op}^1$	$^{2A}S_{op}^1$
CATEGORY IIB: PEOPLE IN NON-SUBMERGING HAMLETS AROUND RESERVOIR RIM	1. GENERAL LIVING STANDARD AND QUALITY OF LIFE	$^{2B}w_c^1$	$^{2B}S_c^1$	$^{2B}w_{op}^1$	$^{2B}S_{op}^1$
CATEGORY IIC: PEOPLE DOWNSTREAM OF THE DAM	1. AGRICULTURE	$^{2C}w_C^1$	$^{2C}S_c^1$	$^{2C}w_{OP}^1$	$^{2C}S_{OP}^1$
	2. FISHERY	$^{2C}w_C^2$	$^{2C}S_c^2$	$^{2C}w_{OP}^2$	$^{2C}S_{OP}^2$
	3. WATER AVAILABILITYAND QUALITY	$^{2C}w_C^3$	$^{2C}S_c^3$	$^{2C}w_{OP}^3$	$^{2C}S_{OP}^3$
	4. DAM FAILURE / SABOTAGE	$^{2C}w_C^4$	$^{2C}S_c^4$	$^{2C}w_{OP}^4$	$^{2C}S_{OP}^4$
	5. WATER MANAGEMENTAND FLOOD CONTROL	$^{2C}w_C^5$	$^{2C}S_c^5$	$^{2C}w_{OP}^5$	$^{2C}S_{OP}^5$
	6. LAND RECLAMATION	$^{2C}w_C^6$	$^{2C}S_c^6$	$^{2C}w_{OP}^6$	$^{2C}S_{OP}^6$

Composite significance value for category IIA: $(^{IIA}S_c)=^{2A}w_c^1.^{2A}S_c^1$, and $(^{IIA}S_{op})=^{2A}w_{op}^1.^{2A}S_{op}^1$

Composite significance value for category IIB: $(^{IIB}S_c)=^{2B}w_c^1.^{2B}S_c^1$, and $(^{IIA}S_{op})=^{2A}w_{op}^1.^{2A}S_{op}^1$

Composite significance value for category IIC: $(^{IIC}S_c)=\sum_{i=1,6}{}^{2C}S_c^i.^{2C}w_c^i$, and $(^{IIC}S_{OP})=\sum_{i=1,6}{}^{2C}S_{OP}^i.^{2C}W_{OP}^i$

Table 7.4 Weightages and Significance Factors for Category III Population

PEOPLE AFFECTED	IMPACT FACTOR OR PARAMETER	CONSTRUCTION PHASE		OPERATION PHASE	
		Weightage	Significance	Weightage	Significance
CATEGORY III: REGIONAL POPULATION NOT IN THE PROJECT AREA, BUT ARE AFFECTED BY THE PROJECT	1. DRINKING WATER SUPPLY	${}^3w_c^1$	${}^3S_c^1$	${}^3w_{OP}^1$	${}^3S_{OP}^1$
	2. INDUSTRIAL WATER SUPPLY	${}^3w_c^2$	${}^3S_c^2$	${}^3w_{OP}^2$	${}^3S_{OP}^2$
	3. IRRIGATION WATER SUPPLY	${}^3w_c^3$	${}^3S_c^3$	${}^3w_{OP}^3$	${}^3S_{OP}^3$
	4. HYDRO-ELECTRIC POWER	${}^3w_c^4$	${}^3S_c^4$	${}^3w_{OP}^4$	${}^3S_{OP}^4$
	5. INDIRECT ECONOMIC DEVELOPMENT	${}^3w_c^5$	${}^3S_c^5$	${}^3w_{OP}^5$	${}^3S_{OP}^5$
	6. NAVIGATION	${}^3w_c^6$	${}^3S_c^6$	${}^3w_{OP}^6$	${}^3S_{OP}^6$
	7. WATER LOGGING AND SALINITY	${}^3w_c^7$	${}^3S_c^7$	${}^3w_{OP}^7$	${}^3S_{OP}^7$
	8. WATER RIGHTS DISPUTE	${}^3w_c^8$	${}^3S_c^8$	${}^3w_{OP}^8$	${}^3S_{OP}^8$

Composite significance value for category IIi: $({}^{III}S_c) = \sum_{i=1,8} {}^3S_c^i . {}^3w_c^i$, and $({}^{III}S_{op}) = \sum_{i=1,8} {}^3S_{op}^i . {}^3w_{op}^i$

Table 7.5 Weightages and Significance Factors for Category IIIA Population

PEOPLE AFFECTED	IMPACT FACTOR OR PARAMETER	CONSTRUCTION PHASE		OPERATION PHASE	
		Weightage	Significance	Weightage	Significance
CATEGORY IIIA: RECENT MIGRANTS TO THE PROJECT AREA	1. DIRECT ECONOMIC DEVELOPMENT	${}^{3A}w_c^1$	${}^{3A}S_c^1$	${}^{3A}W_{OP}^1$	${}^{3A}S_{OP}^1$
	2. INDIRECT ECONOMIC DEVELOPMENT	${}^{3A}w_c^2$	${}^{3A}S_c^2$	${}^{3A}W_{OP}^2$	${}^{3A}S_{OP}^2$
	3. EDUCATION	${}^{3A}w_c^3$	${}^{3A}S_c^3$	${}^{3A}W_{OP}^3$	${}^{3A}S_{OP}^3$
	4. MEDICAL FACILITIES	${}^{3A}w_c^4$	${}^{3A}S_c^4$	${}^{3A}W_{OP}^4$	${}^{3A}S_{OP}^4$
	5. TRANSPORTATION	${}^{3A}w_c^5$	${}^{3A}S_c^5$	${}^{3A}W_{OP}^5$	${}^{3A}S_{OP}^5$
	6. ENTERTAINMENT	${}^{3A}w_c^6$	${}^{3A}S_c^6$	${}^{3A}W_{OP}^6$	${}^{3A}S_{OP}^6$
	7. PUBLIC SAFETY	${}^{3A}w_c^7$	${}^{3A}S_c^7$	${}^{3A}W_{OP}^7$	${}^{3A}S_{OP}^7$
	8. SANITATION	${}^{3A}w_c^8$	${}^{3A}S_c^8$	${}^{3A}W_{OP}^8$	${}^{3A}S_{OP}^8$
	9. PUBLIC UTILITIES	${}^{3A}w_c^9$	${}^{3A}S_c^9$	${}^{3A}W_{OP}^9$	${}^{3A}S_{OP}^9$

Composite significance value for category II: $({}^{IIIA}S_c) = \sum_{i=1,9} {}^{3A}S_c^i . {}^{3A}W_c^i$, and $({}^{IIIA}S_{OP}) = \sum_{i=1,9} {}^{3A}S_{OP}^i . {}^{3A}W_{OP}^i$

Table 7.6 Weightages and Significance Values for the Second Level of Hierarchy

IMPACT FACTOR OR PARAMETER	CONSTRUCTION PHASE		OPERATION PHASE	
	WEIGHTAGE	SIGNIFICANCE	WEIGHTAGE	SIGNIFICANCE
1. CATEGORY I: **PEOPLE DIRECTLY DISPLACED DUE TO SUBMERGENCE OF LAND**	${}^{I}W_c$	${}^{I}S_c$	${}^{I}W_{OP}$	${}^{I}S_{OP}$
2. CATEGORY II: **PEOPLE WHO ARE NOT DIRECTLY DISPLACED, BUT SUBSTANTIALLY AFFECTED**	${}^{II}W_c$	${}^{II}S_c$	${}^{II}W_{OP}$	${}^{II}S_{OP}$
3. CATEGORY IIA: **EXISTING POPULATION IN RESETTLEMENT AREA**	${}^{IIA}W_c$	${}^{IIA}S_c$	${}^{IIA}W_{OP}$	${}^{IIA}S_{OP}$
4. CATRGORY IIB: **PEOPLE IN NON-SUBMERGING HAMLETS AROUND RESERVOIR RIM**	${}^{IIB}W_c$	${}^{IIB}S_c$	${}^{IIB}W_{OP}$	${}^{IIB}S_{OP}$
5. CATEGORY IIC: **PEOPLE DOWNSTREAM OF THE DAM**	${}^{IIC}W_c$	${}^{IIC}S_c$	${}^{IIC}W_{OP}$	${}^{IIC}S_{OP}$
6. CATEGORY III: **REGIONAL POPULATION NOT IN THE PROJECT AREA, BUT AFFECTED BY THE PROJECT**	${}^{III}W_c$	${}^{III}S_c$	${}^{III}W_{OP}^{6}$	${}^{III}S_{OP}$
7. CATEGORY IIIA: **RECENT MIGRANTS INTO THE PROJECT AREA**	${}^{IIIA}W_c$	${}^{IIIA}S_c$	${}^{IIIA}W_{OP}^{7}$	${}^{IIIA}S_{OP}$

- Final score for Construction Phase (S_c) =
  ${}^{I}W_c.{}^{I}S_c+{}^{II}W_c.{}^{II}S_c+{}^{IIA}W_c.{}^{IIA}S_c+{}^{IIB}W_c.{}^{IIB}S_c+{}^{IIC}W_c.{}^{IIC}S_c+{}^{III}W_c.{}^{III}S_c+{}^{IIIA}W_c.{}^{IIIA}S_c$;
- Final score for Operation Phase (S_{OP}) =
  ${}^{I}W_{op}.{}^{I}S_{op}+{}^{II}W_{op}.{}^{II}S_{op}+{}^{IIA}W_{op}.{}^{IIA}S_{op}+{}^{IIB}W_{op}.{}^{IIB}S_{op}+{}^{IIC}W_{op}.{}^{IIC}S_{op}+{}^{III}W_{op}.{}^{III}S_{op}+{}^{IIIA}W_{op}.{}^{IIIA}S_{op}$
- S_c and S_{OP} will be used as significance values in the third level of hierarchy

resources projects. The first task of the RPCT technique is to rearrange these parameters in descending order of importance. For example, let the seven components in Table 7.6 be ranked as follows: Category III, Category I, Category II, Category IIC, Category IIA, Category IIIA, and Category IIB. The next task is to rank contiguous parameters according to the scheme given below. The first- ranked impact factor (i.e., Catergory III) is assigned a value of 1. The next impact factor (i.e., Category I) is assigned a value x_1, where $0 \leq x_1 \leq 1$. This means that the second category is considered to be only "x_1" times as important as the first category. The third ranked parameter is compared with the second ranked parameter, and assigned a value "x_2", where $0 \leq x_2 \leq 1$. This signifies that the third parameter is only "x_2" times as important as the second parameter. Thus, relative weights are assigned to all impact factors in a particular list.

As in the case of impact evaluation, a committee (preferably different from the ones appointed for impact evaluation, as described earlier) should also perform the assignment of weightage. A different committee should preferably be constituted for each list, i.e., Tables 7.1, 7.2, 7.3, 7.4, 7.5, and 7.6. As in the previous case, the committee should reach a consensus decision on the ranking of impact factors.

For the seven impact factors in Table 7.6, let the assigned relative values be x_1, x_2, x_3, ..., x_7. Corresponding absolute weights will be, $v_1 = x_1$, $v_2 = \prod_{i=1,2} x_i$,....., $v_7 = \prod_{i=1,7} x_i$.

It has been suggested by Manish Kumar (1998), that while RPCT is more suited to seek judgements from various people, the analytical hierarchy process (AHP) is better for integrating these judgements to arrive at a final decision.

In the AHP process, relative weights of various elements are established in a scale of 1-9. As shown in Table 7.7, the impact factors in a list are arranged in the form of a matrix. Each element of the matrix is assigned a value Q(i,j), where Q(i,j) reflects the importance of element i over element j. Q(i,j) can have any value in the range $1 \leq i, j \leq 9$, provided $i \leq j$. Thus, if i^{th} and j^{th} parameters are of equal importance, then Q(i,j) is given a value of 1, if the i^{th} parameter is slightly more important than the j^{th} parameter, then Q(i,j) is given

a value of 2 or 3, if the i^{th} parameter is marginally more important than the j^{th} parameter, then Q(i,j) is given a value of 4 or 5, if the i^{th} parameter is substantially more important than the j^{th} parameter, then Q(i,j) is given a value of 6 or 7, and if the i^{th} parameter is far more important than the j^{th} parameter, then Q(i,j) is given a value of 8 or 9.

Table 7.7 Matrix for AHP Process

i ↓ Q(i,j) / j →	Cat I	Cat II	Cat IIA	Cat IIB	Cat IIC	Cat III	Cat IIIA
Cat I	Q(1,1)	Q(1,2)	Q(1,3)	Q(1,4)	Q(1,5)	Q(1,6)	Q(1,7)
Cat II	Q(2,1)	Q(2,2)	Q(2,3)	Q(2,4)	Q(2,5)	Q(2,6)	Q(2,7)
Cat IIA	Q(3,1)	Q(3,2)	Q(3,3)	Q(3,4)	Q(3,5)	Q(3,6)	Q(3,7)
Cat IIB	Q(4,1)	Q(4,2)	Q(4,3)	Q(4,4)	Q(4,5)	Q(4,6)	Q(4,7)
Cat IIC	Q(5,1)	Q(5,2)	Q(5,3)	Q(5,4)	Q(5,5)	Q(5,6)	Q(5,7)
Cat III	Q(6,1)	Q(6,2)	Q(6,3)	Q(6,4)	Q(6,5)	Q(6,6)	Q(6,7)
Cat IIIA	Q(7,1)	Q(7,2)	Q(7,3)	Q(7,4)	Q(7,5)	Q(7,5)	Q(7,7)

The absolute weights obtained by RPCT technique can be converted to the AHP format by using the conversion factors shown in Table 7.8.

Table 7.8 Coversion Scale Between RPCT and AHP (Kumar, 1998)

RPCT Scale (w_i/w_j)	1.00-1.12	1.12-1.28	1.28-1.50	1.50-1.78	1.78-2.22	2.22-2.95	2.95-4.35	4.35-8.33	8.33-∞
AHP Scale, Q(i,j)	1	2	3	4	5	6	7	8	9

Note: 1. $i > j$.
2. Putting these values will complete the upper triangular matrix in Table 7.7. The lower triangular matrix will be a mirror image, with reciprocal values.

Following points should be kept in mind when assigning weights to various impact factors. In general, short-term (ST) impacts should be assigned lower weightages than long term (LT) impacts. Similarly, impacts which are local/regional (LR) in nature should be, in general, assigned greater weightage than regional/global (RG) impacts. Thus in Table 7.9, the impacts in the construction phase, which are ST, should be assigned lesser weightage than impacts in the operation phase, which are LT. Similarly, in Table 7.6, impacts on population belonging to category I, II etc., which are LR, should

be assigned greater weightage than impacts on those belonging to category III, which are RG, provided the number of people belonging to the former two categories are high.

7.3 Tabulation of the Final Score

After the weightages are converted to the AHP format, Eigen values for each row in Table 7.7 is calculated as follows: $I_i = \left[\prod_{j=1,7} Q(i,j) \right]^{1/7}$. Weightages for each parameter is then calculated as follows: $w_i = \frac{I_i}{\sum_{i=1,7} I_i}$. This ensures that $\sum_{i=1,7} w_i = 1$. Thus the final score can be calculated simply as $\sum_{i=1,7} w_i . S_i$, where S_i is the significance value, as described in chapter 6. Calculations are done in a hierarchical procedure, with the impact factors in the first level of hierarchy being synthesised first. These results are then incorporated in the second level of the hierarchy, the third level, and so onn, until a final score is obtained. Such calculations are shown in Tables 7.1 to 7.6. Calculation of the final score is shown in Table 7.9.

Table 7.9 Weightages and Significance Values for the Third Level of Hierarchy

IMPACT FACTOR OR PARAMETER	WEIGHTAGE	SIGNIFICANCE
CONSTRUCTION PHASE	W_C	S_C
OPERATION PHASE	W_{OP}	S_{OP}

Note: Final Score for the Project (S): $S = W_c.S_c + W_{OP}.S_{OP}$

The final score S should have a positive value, if the project is to be feasible from a socio-economic perspective. In fact, it is desirable that the value of S is greater than +30, i.e., the project should at least have a medium beneficial impact on the affected population. In case this is not so, additional mitigation measures could be incorporated in the project planning, so as to reduce the adverse impacts of the project.

CHAPTER 8

CONCLUSION

A review of the economic policies of the Indian state since its inception in 1947 indicates that our leaders adopted the 'industrilisation and urbanisation' model of development. Such was the zeal to industrialize, that our first Prime Minister, Pandit Jawaharlal Nehru, called large industrial projects, 'temples of modern India'. This model has brought unquestionable progress is many fields. However, the rate of progress has been slow, leading to a persistence of poverty in the country. Another unacceptable consequence of development has been the accompanying environmental degradation, and the systematic impoverishment of the natural resource base upon which rural poor depend for survival.

An often heard complaint regarding large infrastructural projects is that the benefits from such projects go to a particular section of the society, while the costs and the ill-effects of the accompanying environmental degradation is disproportionately bourne by the rural poor and tribal people. Realisation of this fact has led to widespread discontent among the affected population, which has to suffer due to such project implementation. Manifestation of this resentment can be seen in several popular movements against large water resources projects, e.g., the 'Narmada Bachao Andolan' in Gujarat and Madhya Pradesh.

The concept of sustainable development, which has emerged in recent years, stresses on economic growth within the limits of ecosystems' carrying capacity. Recent thinking on this subject indicates that sustainability of developmental projects is essential, keeping the long-term consequences in mind. An essential component of sustainable development is the use of environmental impact assessment as a developmental tool. Defining the word "Environment" to include not only the physical environment, but also the social, economic, cultural and aesthetic environments can broaden the scope of EIA. In effect, this definition brings all the human-interest issues under the purview of EIA. Socio-economic impact assessment (SIA), which is a part of the EIA process, is a mechanism for determining the impact of a developmental activity or project on the social and economic activities of the affected population.

The primary objective of a SIA study is to identify, analyse and assess the socio-economic impacts of a project. It must be realised that the project will have differing, i.e., beneficial, adverse, or non-existent impacts, or a combination of the above, for various categories of people affected by the project. This aspect must be incorporated into an SIA study. Incorporation of mitigation measures, which act to reduce the adverse impacts of a project, must also form an inherent part of such a study. Finally, based on such an analysis, a decision must be made regarding the suitability of the project from a socio-economic perspective.

Pressure from the funding agencies like the World Bank, Asian Development Bank, and other financial institutions to improve the state of social environment has forced the Indian government to conduct the SIA for both the existing and proposed projects. However, such studies are easier to conceptualize, than to implement. There are serious problems in proper identification, and assessment of the issues relating to the socio-economic aspects of developmental projects. This is because the issues are nebulous, complex, highly nuanced, difficult to define, and not amenable to quantification. This is one of the reasons for the cursory treatment of socio-economic impact factors. Consideration of these issues is often treated merely as a formality to satisfy the monitoring agency requirements. Hence, the quality of such studies is very low.

Proper implementation of the concept of SIA is essential is attaining the goals of sustainable development, and stop the continued impoverishment, social dislocation, and marginalization of the weaker sections of our society, who seem to be disproportionately affected by large water resources development projects. Implementation of the concept of SIA requires a well-defined methodology, which was lacking. The methodology presented in this dissertation should help in conducting SIA studies for large water resources projects effectively. The plan of action starts by identifying and categorising the affected population into sub-groups, depending on the nature and extent of impacts. This is followed by identification of parameters or impact factors that are relevant for each of these sub-groups. Next, guidelines are provided for conducting both baseline and

predictive studies for determination of the nature of impacts. Impact evaluation, which involves impact assessment and assignment of significance numbers, is the next step. Assignment of weightages to various impact factors follows, and synthesis of the above information into a final score or index is the last step. The acceptability or otherwise of the project from a socio-economic perspective may be determined based on the results of such a study.

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APPENDIX A

DEBATE ON LARGE WATER RESOURCES PROJECTS

A1. Introduction

A fierce debate has been raging in the country regarding the suitability, desirability and long-term consequences of large water resources projects. The popular opposition to the Narmada Valley and other similar projects stimulated this debate. Participants in this debate range from the environmental activists, popular media, to the academic circles. According to Dhawan (1990), among the critics are both the hard and the soft ones. The hard ones are the environmentalists, the social scientists, etc. They raise objections on discipline specific grounds. But the soft ones reveal a rather nebulous understanding of the complex issues of water resources involving ecological matters, who often oppose for ideological reasons.

Though initially confined to technical and specialist matters, the debate has now veered to issues of a much broader and fundamental nature. It reflects a clash of two distinct viewpoints on the question of development. Those critical of construction of large dams explicitly argue that the large water resources projects should be viewed in the context of an overall strategy of 'development', which is overimposing on and alienated from the people of the region and hence is undesirable in principle.

Dhawan (1990) is of the view that, since of the considerable benefits can accrue from properly designed water resources projects, and their indubitable role in economic development of the nation, planners and protagonists of such projects have adopted an attitude of dismissing the critics without a reasoned debate with them. This has resulted in publication of alarmist and unsubstantiated apprehensions of the dam antagonists in the popular press. As a result of this one-sided propaganda in the media, the opposition to such projects have become popular and fashionable in large sections of our society. This view is severely criticized by Baba Amte (1990), who says that the reason why the protagonists are disinclined to debate is that in an open fair debate, not only their vested

interests will be exposed but they would also not be able to counter the objections of the critics.

To participate and constructively contribute to this debate, it is necessary to have clear understanding of various issues involved. Critics oppose large water resources projects from four angles like, environmental, land degradation, seismic, and socio-economic. These aspects will be briefly discussed in the sections that follow.

A1.1 Environmental Angle

The main concern of the environmentalists is that large water resources project cause large-scale deforestation, and consequent loss of biodiversity. According to Dhawan (1990), a dam can reduce forest in two ways. First, the reservoir behind a dam can submerge a forest on the upstream side. Second, the dam activities can lead to removal of the nearby trees for building project roads and housing colonies. As far as the submergence aspect is concerned, the damage on this account is probably a small proportion to the total damage to the forest. Illegal felling of trees, encroachment of forest-land, allotment of forest land to dam displaced people, increased pressure from grazing animals, etc., in the project area contributes more to deforestation. According to Dhawan the total forest area lost so far in India due to submergence by reservoir created by all big dams amount to about 5% of the total forest area lost since independence. The problem of our vanishing forest is not going to be solved by calling halt to the construction of big dam. But whenever the forest cover to be lost by a single dam is unduly high as in case of Narmada Sagar, it is worthwhile to minimize such loss by reducing the height of the dam. However this approach is criticized by Pataria (1992), who says that just because we are unable to control the other 95% of the forest loss, it does not mean that we should allow 5% of forest loss due to dam construction. More importantly it is necessary to understand that these kinds of dams are an integral part of 'development' process which is responsible for the other 95% of the forest loss.

A.1.2 Water Logging and Salinity

According to Dhawan (1990), a major area of concern relates to land degradation due to water logging and soil salinity within canal commands served by big reservoirs. Past experience has shown that canals do give rise to problems of water logging and salinity. But the statistics quoted in this regard are of questionable magnitude and relevance. Quite often the cited statistics are for entire land area suffering from water logging and salinity, without any separation of the area affected due to canals and due to other causes, natural and man made. The problem of water logging is not an inevitable consequence of dam building, it could be effectively checked with adequate provisions for drainage and by use of drip or sprinkler mode of irrigation. But according to Thukral (1992), major investments are necessary for the construction of proper drainage works and irrigation systems in the command area for minimising the effects of water logging and salinity. Such investments are often not feasible, and hence not made. He also mentions that the benefits accruing from enhanced irrigation caused by the implementation of a large water resources project are often calculated disregarding the fact that owing to lack of drainage, gradually in long run more and more land in the canal command area would get degraded. This fact must be properly accounted for in the cost benefit analysis to justify the project on economic grounds.

A1.3 Seismic Angle

Another area of concern relates to damage from earthquakes. There is an apprehension that the huge mass of water behind the dam may induce seismic disturbance in the neighborhood area. The increased seismic activity around Koyana reservoir and its ultimate failure is cited as an example by the dam antagonists. It is not that all the reservoirs induce seismicity. According to Dhawan (1990), geologists and seismologists can best resolve this issue. It is true that a major breach in a dam following an earthquake of severe intensity could be an instrument of utter disaster instead of economic development. But by using modern technology in dam construction this risk can be minimized to a great extent.

A.1.4 Socio-Economic Angle

It is necessary to take note of the beneficial socio-economic changes which large water resources projects bring about. These include the increase in irrigation potential, generation hydroelectric power, and general economic development in the command area and beyond. These must be balanced by the adverse effects, which may include the displacement of people in the submergence area, and the general impoverishment and marginalisation of the people in the project area, who are not displaced, but profoundly affected. Another consequence of such projects is the rise in land values in the project area with the prospect of irrigation. Rich farmers tend to buy up the land in the command area, and the cropping pattern becomes more water intensive. The easy availability of canal water and the political difficulties in pricing it economically lead to wasteful use of water and consequent water-logging and salinity problem. All this results in social inequality and injustice, along with long term impoverishment due to land degradation.

Even when the displaced people are given alternative land as compensation some problems are noticed. The value of land needed for the project is generally estimated at a price that is generally below the prevailing market price, which leads to inadequate compensation payment. Finding of alternative land for the displaced people in nearby areas is another difficult problem. Quite often they are resettled in far off areas like those displaced by Pong dam were given land in Rajasthan, and that too not as a whole village but as individual families. This leads to mental agony and social dislocation, and thus is something which is difficult for displaced people to accept (Agarwal, 1985). Additionally, attempts to settle the displaced people in new areas is not always welcome, both by the affected and the host population (Dogra, 1992).

It is also equally difficult to find suitable land for compensatory afforestation to offset forest loss. The loss of such common property resources is not at all compensated (Dogra, 1992). However according to Dhawan there is no need to take a gloomy view as certain adverse consequences and social evils are inherent in such projects. What should be seen is the benefits that such projects bring with them such as flood control provision of water to arid or drought prone areas, irrigation leading to increased agricultural

production, income generation and secondary occupation, generation of power and its contribution to industry and much more.

In the light of the ongoing debate on direct and indirect cost and benefits, it is clear that the desirability of such projects can only be determined on a case specific basis. This can be done by weighing the cost against the benefits and approving those projects, which have a certain excess of benefits over costs.

The concept of socio-economic impact assessment (SIA) is geared towards formulating a methodology for assessing these concerns in an objective and systematic manner. In such a study, a high level interdisciplinary group of professionals, including engineers, agricultural specialists, soil scientists, experts in land and water use, ecologists, sociologists, economists and others to conduct a detailed study of the existing socio-economic scenario and try to predict the impact of the project on this condition. Based upon this information, a decision is taken regarding the feasibility of the project from the socio-economic perspective.